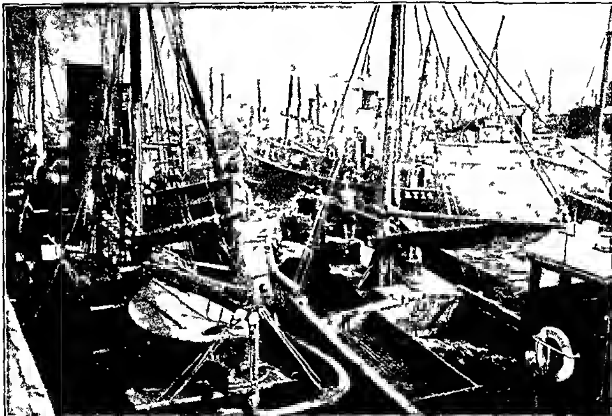
THE SEA FISHERIES



SCOTTISH STEAM DRIFTERS

THE SEA FISHERIES

BY

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OF GRAY'S INN, BARRISTER-AT-LAW

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Hurrah! the seaward breezes
Sweep down the bay amain;
Heave up, my lads, the anchor!
Run up the sail again!
Leave to the lubber landsmen
The rail-car and the steed;
The stars of heaven shall guide us,
The breath of heaven shall speed.—WHITTIER.

PREFACE

THE book finished, the more pleasant task remains, and that is to thank the numerous friends who have by their assistance and co-operation rendered its writing possible. Since an adequate knowledge of the sea fisheries can only be obtained in one place, and that is at sea, I have to thank many fishermen of all classes from the steam trawler skipper to the humble cockler for their invariable kindness in explaining the mystery of their craft. That I have avoided mistakes in comprehending their instruction is, I fear, not to be expected; but one hopes that the mistakes are neither numerous nor serious.

I count it an honour that the greater number of my friends and acquaintances is to be found amongst the fishing population. Although the nature of my duties has frequently brought me into collision with what they have doubtless considered their rights and privileges, I am proud to think that I have never received aught but courtesy at their hands.

No finer body of men is to be met with anywhere than British fishermen; this statement can be made with confidence by one who has spent much time with them, in fair weather and foul; and no one can have more hearty wishes for their prosperity than the author of this volume. To the Lancashire and Western Sea Fisheries Joint Committee, whose servant I have been for fifteen years, I am indebted for permission to make use of photographs originally taken to illustrate reports on the fisheries within their jurisdiction. I should like also to take the opportunity of thanking the Committee, both individually and collectively, for many acts of kindness and consideration, which have been far more numerous than I have deserved.

To Dr. Wemyss Fulton, the Scientific Superintendent to the Scottish Fishery Board, I am indebted greatly, both for encouragement when the book was in the making and subsequently for advice and assistance, without which it is to be feared that errors and omissions would have been far more numerous than they are. At the same time it is proper to state that for the opinions in the book the author is solely responsible.

Dr. Hugh M. Smith, Commissioner of Fisheries to the United

States of America, was good enough to revise that portion of the last chapter dealing with fishery administration in the United States Owing to his courtesy I am able to give more recent statistics of the United States operations than would otherwise have been available I am also indebted to Dr Smith for the photographs illustrating the United States fisheries

For the illustrations of the great Scottish Herring Fishery I am indebted to Mr Norrie of Fraserburgh Practically all the remainder are from photographs by Mr Andrew Scott of the Marine Laboratory, Piel, Barrow-in-Furness, for whose willing assistance I am much obliged The drawings of the modern otter trawl are from sketches and material furnished by Mr Manton, Principal of the Technical School for Fishermen at Hull For permission to reproduce a print of exceptional historical interest I have to thank Mr Wylie, Provost of Stromness This print which shows the assembling of the Scottish herring fleet off Brassa in Shetland, probably refers to the first assembly in 1750, in order to participate in the benefit of the tonnage bounty secured by an Act of Parliament passed in that year From this gathering the present Scottish herring fleet dates its origin The print is dated from the London Magazine of 1752 Another print of the same period shows the *Pelham* and *Carteret* busses, which are further referred to in Chapter V, at sea off Brassa in the Shetlands on the 14th July, 1750 Other prints showing the evolution of the trawl and the ancient method of drifting for herring are from Duhamel's account of the Sea Fisheries, published at Neuchatel in 1776, and from the fishery plates in Diderot's great Encyclopédie (1751–77)

Students of the evolution of methods of sea fishing would do well to consult a " Recueil de planches de L'Encyclopédie Planches des pêches," published by Panckoucke at Paris in 1793 Many of the illustrations are from the earlier works above referred to, but others are new I am unable to verify the title of the Encyclopédie, but the volume in my possession is entitled (on the binding) " Encyclopédie Méthodique "

I am also obliged to Mr John Murray for permission to quote from an article I contributed to the *Quarterly Review* to Messrs Cassell and Co for permission to use illustrations of the development of the plaice taken from Dr Francis Ward's *Marvels of Fish Life*, and to H M Stationery Office for the use of two charts on which are based the maps of the trawling and fishing grounds

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16 WALTON'S PARADE
PRESTON

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INTRODUCTION

OVER fifteen years' experience in the service of the largest of the local fishery committees in England and Wales leads one to believe that there is a real desire for further knowledge of the sea fisheries. Delegates of foreign and colonial Governments, members and would-be members of Parliament and representatives of various local authorities contributing to the expense of sea fishery administration have in turn sought information as to the conditions under which the sea fisheries are now carried on. The nature of the questions asked, covering as they have done practically all the branches of fishery research and administration, gives one a clue to the kind of information desired, and the absence of any single volume which deals with or gives references to the many and diverse problems to be studied has led to the writing of the present book.

Necessarily much of the information, if it is to prove of any value, should be supplemented by actual observation on the fishing grounds as well as by reference to the original authorities.

The outbreak of the European war in 1914 naturally influenced the fisheries of North-Western Europe to a profound degree. In some instances, as in the Scottish herring fisheries, the fishing was after a time entirely suspended. In other instances the fishing was carried on under very difficult conditions, as in the case of steam trawling in certain areas. On the other hand, inshore fishing was probably the least affected, and since the scarcity of fish caused an all-round increase of prices, the inshore fisherman benefited. All branches of the industry contributed—as those who knew them foresaw—liberally in men, and, when required, in vessels to the national defence; and this again affected the yield in the war period.

So far as one can judge the war's effects on the sea fisheries of the British Isles will prove of a transient nature. Even the Scottish herring fisheries will in all probability recover rapidly. Twice before these fisheries have lost their markets as suddenly as they did the German and Russian markets in 1914; firstly the loss of the West Indian market owing to the emancipation of the slaves, and secondly the loss of the Irish market at the time of the potato

famine It may perhaps be necessary to explain here that in the main the great Scottish drift-net fisheries for herring depend on an export trade in cured fish, whereas the great English trawl fisheries depend on the sale of fresh fish in the home markets

On the whole one may anticipate a rapid recovery and a return to normal conditions in British sea fishery affairs within a reasonable, if at present indefinite, time

The closure of certain grounds to fishing as a measure of naval precaution will naturally lead to abnormal statistical returns for some time after the war is over, and the loss of trawlers and drifters in the operations of war will prove another disturbing factor The statistics for 1914–19 and possibly for a year or so afterwards are therefore not useful for comparison with previous years save as a measure of the loss to the trade as a result of the war, and in the arguments set out in the succeeding chapters no account is taken of any figures subsequent to 1913

It is to be expected that the old ante war problems which vexed the fishery world will speedily recur, possibly in an accentuated form What these problems are, how they have arisen, and the best means of grappling with them are dealt with in the following pages The opinions set forth will probably be considered unorthodox For them the author must accept the sole responsibility The facts on which they are based have been verified carefully, but should be checked whenever possible by reference to the official and other returns The administration of the sea fisheries is not quite so simple as may be thought, and in spite of the expressed opinion of the Minister who was responsible to Parliament for the fisheries of England and Wales so recently as 1912, ignorance of the subject does not, any more than it does in any other subject, confer any special advantage on those responsible for the administration In the case of shore going industrial concerns, such as a cotton mill or a coal mine, the test of efficiency may be to obtain the greatest output and the largest profit with the least expenditure of time, money and labour But the sea fisheries are hardly on the same level The maximum productivity with the minimum of workers may not be the ideal policy, even for immediate purposes, and no one can complain that the tendency of modern administration is to consider anything beyond immediate necessities

In an industry where man reaps but does not sow, the question of the future supply ought always to be present, and to what extent this question has already forced its way to the front will be seen in the following chapters Moreover, although one does not wish to deprecate the cry of the cheapest food for the greatest number, it

must not be forgotten that the other problem of securing a means of livelihood to a large class of men is also of no less importance.

A man earning £5000 a year may not be ten times as useful to the State as one earning £500 a year, and a group of fishermen whose aggregate earnings are from a financial standpoint contemptible and whose landings of fish would only suffice for a very small community are not necessarily of no account to the nation.

If this volume has any special cause to plead it is that of the inshore fisherman. It ought to be—it is—possible to secure for him reasonable conditions of existence without in any way curtailing the field of operations or the dividends of the big steam fishing companies. To the latter bodies the very greatest credit is due for opening up sources of food supply to the country which otherwise would be unavailable. Carried on at a reasonable distance from the coast there can be no possible objection to the operations of large vessels fishing on an extensive scale. Although such methods of fishing have not resulted, as is so frequently claimed, in cheapening the supply of fish (see Appendix, p. 274), they have secured a steady and constant supply to our big industrial centres, which would otherwise only rarely see marine fish in their markets.

The questions of the preservation and improvement of the sea fisheries ought properly to be considered after the book has been perused. But it is convenient to summarise certain arguments here. It cannot be said, in spite of the numerous committees and commissions which have been appointed of recent years, that there has been much progress in fishery administration. The three central departments for fisheries, i.e. England and Wales, Scotland and Ireland vary much in efficiency; and one proposed remedy for the present admitted defects is the absorption of the three departments into one. This "remedy" has found much favour in English administrative circles, but it is understood to be less favourably regarded in Scotland and Ireland. The Committee on Ichthyological Research (1902) recommended the appointment of a conference, consisting of representatives of the three Central Authorities "to secure uniformity of action between scientific bodies at work in the seas surrounding the United Kingdom, and to prevent overlapping of areas of research." The question of general administration as distinguished from scientific investigation was not before this committee. Similarly the Committee on Fishery Investigations (1908) advocated a Central Council for the United Kingdom to control public funds for fishery investigations of a national and

international character, but here again there was no question of union or fusion for general administration [1]

In 1914 the Reports of two fishery committees were published, the Departmental Committee on Inshore Fisheries (Board of Agriculture and Fisheries) and the Scottish Departmental Committee on the North Sea Fishing Industry The Report of the former committee contains no reference to the question of joint administration, but the *evidence given* before it by the official representative of Irish Fisheries (the late Mr W Spotswood Green) shows that Ireland, at any rate, did not desire a Central Authority for administrative purposes The Scottish Report contains no evidence of a desire on the part of Scotland to amalgamate with the other countries

It is evident, therefore, that such desire as exists is to be found at the Board of Agriculture and Fisheries, and, indeed, there is proof that the Board wish to absorb the other two departments The National Sea Fisheries Protection Association at their Conference at Great Yarmouth in 1909 passed a resolution in favour of one Central Authority for the United Kingdom, and at their Annual General Meeting in 1916 the head of the fisheries department at the Board of Agriculture and Fisheries is reported to have expressed himself as follows " His proposal was that in order to get real progress they wanted to get rid of the present anomalous situation in which the fisheries of the United Kingdom were administered by three separate departments It was almost as if they had three Admiralties for three component parts of the kingdom He had great hopes that in some dim and distant future there would be one central administration for fisheries "

It is to be feared that these hopes are doomed to disappointment There is, then, little or no reason to believe that any improvement in administration would be effected by the fusion of the three central departments As will be seen from the context, the departments in both Ireland and Scotland are well administered In the former country the possibility, to put *it no* higher, of Home Rule makes any discussion of amalgamation unreal, and the latter country with a Fishery Board of high standing and a fine record is hardly likely to be so ill advised as to consent to relinquish control of its fisheries

To consider now each of the three countries separately, we find that in Scotland there is a separate Fishery Board, while in Ireland and England the fisheries are associated with another department,

[1] There is an Addendum to the Report of the Committee of 1908 (signed by five of the ten members) urging the necessity of centralising the general fishery administration of the United Kingdom This recommendation was not subscribed to by either the members representing Scotland or Ireland on the Committee

in the former case with Agriculture and Technical Instruction (in congested districts the Congested Districts Board), in the latter with Agriculture. Which of these three methods is to be preferred?

In England the fisheries were formerly at the Home Office; in 1886 they were transferred to the Board of Trade and finally in 1903 to the Board of Agriculture. In 1919 the Board of Agriculture was organised in five divisions: Land, Intelligence, Statistics, Animals and Fisheries, each in charge of an Assistant Secretary. The association of Agriculture and Fisheries in a maritime country like England is a mistake, and probably arose from an erroneous analogy with those countries, e.g. Russia and Sweden, in which the fresh-water or inland fisheries predominate, and where the two departments are combined. There can be no question but that this unnatural association has reacted unfavourably on the fisheries and should be terminated at the first favourable opportunity. The Board of Trade having been already tried and found wanting, there remain two alternatives. Either the Fisheries Department should become a subordinate department at the Admiralty or it should be a separate department, the head of which, a permanent Civil Servant, should be responsible direct to the Home Secretary.

There is a good deal to be said in favour of transferring the Fisheries to the Admiralty. It is impossible to ignore the value of fishermen to a country whose first line of defence is the Navy, and it must not be forgotten that in modern naval warfare there is much of the greatest value that can be done by fishermen, even though they have not been trained in the Navy or Naval Reserve.

There is, however, one great, and in the writer's opinion fatal, objection to the transfer of the administration of the fisheries to the Admiralty, and that is the extent of the burden the latter has to bear. At the most favourable interpretation the Fisheries would be a small and relatively unimportant department, and its administration would come to be regarded as a perquisite of the less brilliant members of the Admiralty staff. Moreover, naval discipline is hardly suited to the needs of the fisheries, which at the present time require encouragement, not repression. If we regard the normal life of a nation as peaceful, then the normal activities of fishermen must be the catching of fish. If in spite of this, preparations of a war-like nature have to be made in times of peace, then fishermen, like other classes of the community, must take their share of such preparations. But to admit that this must be the main occupation of the fisherman is to despair of the future. For these reasons, which might be developed at greater length, one is inclined to reject the association of Fisheries administration with the Admiralty.

There remains the alternative of a Central Fishery Board for each country, the chief permanent official being responsible direct to the Secretary of State Ireland may well be left out of account, since the Irish will probably be left to settle their own administration , Scotland already has a model of this kind, and an excellent one it has proved, as reference to the following pages will show

A Central Board in each country formed for the special purpose of fisheries administration or a department directly responsible to the Secretary of State are the only possible alternatives if the country is to have a satisfactory scheme The objections to a Board are almost certainly outweighed by the advantages In Scotland, at present, the Fishery Board consists of a salaried chairman, who, however, is not a member of the Civil Service, and six additional members (unpaid) Four of the members should be "representative of different branches of the fishing industry," the other three being ex officio members The Scottish Departmental Committee of 1914 were much interested in the form of central fishery administration of the various North Sea countries The Committee reported, " In so far as in Scotland we have a separate department for fisheries and not a branch of the ministry of agriculture, we are more fortunate than these countries From the tendencies visible at work therein, we are convinced that fishery administration is best managed through a department under a minister responsible to Parliament, and our foreign studies have confirmed this view " This strengthens the opinion one had already formed from an independent study of the question, and it is certain that very little improvement in fishery administration is to be expected in England and Wales until a more resourceful Central Authority is established

Members of the Scottish Fishery Board hold office for five years, but it has been customary for some time to reappoint the chairman, the scientific and legal members Other members come and go, and it is evident that the Departmental Committee do not regard this as an unmixed blessing, since they report, " There can be no disguise of the fact, however, that appointments to the Board being made by the Government of the day have the character which all such appointments have," but if the Committee assume that the staffing of other Central Fishery Departments in the British Isles is free from the suspicion of political or social influence, they are labouring under a misapprehension The Departmental Committee recommend the abolition of the Fishery Board as at present constituted The fishery administration in Scotland should be entrusted to a permanent head, who should be a member of the Civil Service,

acting under the instructions of the Secretary for Scotland. As an alternative they recommend that the Chairman of the Fishery Board should be a permanent official, other provision to be made for the functions at present discharged by the sheriff and the scientific member, leaving the other four members as at present.

The Central Fishery Department in England and Wales has for many years laboured under two great disadvantages ; a too frequent change of the political head, and the understaffing of the department. During the fifteen years from 1902–16 there were no less than eight different ministers responsible to Parliament for the Fisheries, and it is no exaggeration, and no reflection on the minister in view of the multiplicity of other interests he was responsible for, to say that most of them were frankly indifferent to fishery interests.[1] Again the method of presenting the fishery estimates, as a branch of and largely indistinguishable from those of Agriculture and the allocation of an evening or the part of an evening for the consideration of the estimates by Parliament, has not tended in the direction of the improvement of administration. The fact of the matter is that under the party system of Government, the House of Commons has lost all effectual control over the great spending departments of the State.

When local authorities have been treated unfairly, or think they have been treated unfairly by the Central Department, effectual protest is practically impossible A division of the House on a matter which might well be vital to the interests of the fishermen over a large extent of coast is so rare as to be almost unheard of. An instance occurred in 1912. The County Council of Glamorgan and the City Council of Cardiff objected to certain provisions in an order establishing a Fishery District for South Wales. It is unnecessary to enter into the merits of the dispute ; the Board of Agriculture and Fisheries may well have been in the right and the protesting Local Authorities may well have been in the wrong.

What happened was a division of the House on strictly party lines, 183 members (including 49 Irish Nationalists) voted for the Government, i.e. the Board of Agriculture and Fisheries, and 62 for the Opposition, i.e. the Local Authorities. No one can pretend that the House of Commons exercised the slightest judicial function in this matter.

There remains but one method of protest open to Local Authorities when they feel aggrieved, and that is the repetition of questions

[1] Some years ago at a Conference of Representatives of Local Fishery Authorities the President of the Board of Agriculture and Fisheries remarked in an audible voice, apropos of an item on the Agenda, " What *is* a berried lobster ? " A very little forethought would have avoided a contretemps of this kind.

addressed to the head of the department responsible for fisheries It is not merely a case of an occasional question, but the question must be repeated under slightly different forms for weeks or months, it may even be for years Few permanent officials care for repeated publicity of this kind and eventually they find it more agreeable to yield than to remain obstinate This method was adopted by one of the Local Committees in England and Wales, when an application of theirs for a grant-in-aid of fishery research had apparently been lost sight of by the Central Department The original application was forwarded in May, 1910, questions commenced to appear in March, 1911, and were repeated at regular intervals, until in November, 1911, a reply was received to the main question that it was proposed to make a grant, and in March, 1912, details of the proposed grant were announced The replies to the questions were invariably as evasive as possible, and occasionally inaccurate, but ultimately a definite reply was received nearly two years after the original application had been sent in

A condition of public administration whereby it is possible, and given favourable circumstances certain, for an error of judgment on the part of a quite subordinate official to become adopted by the Central Authority, and with the official sanction of the President forced through an indifferent and apathetic House of Commons by a strictly party vote, is reprehensible and means should be found of altering it

Where the heads of the administration lack the expert knowledge, which alone would enable them to carry out their duties in the public interest, the above danger is always present

Assuming then that a separate department is the best for the fisheries, how should it be staffed to secure efficiency in administration? It must be admitted that somewhere in the department expert knowledge is essential, even though it be open to question as to whether the chief official responsible to the Government for the Fisheries should know anything of the subject he professes to advise upon It is no reflection on the erudition of the gentlemen concerned to say that quite recently the Political Head, the Permanent Secretary and the Assistant Secretary in special charge of the Fisheries of England and Wales were alike ignorant of the subject they were responsible to the country for

In fact the Political Head in charge of the Department in appointing a successor to a retiring official for the last-named appointment said " His place has to be filled, and I hope to fill it by an administrative officer who will be able to take a wide view of his duties It has been suggested that no one but a first-class expert should fill that post My experience of experts is that they are expert on

only one topic, and on only one side of that topic, and nothing could be more undesirable than that the Board of Fisheries should be heavily overloaded on one side or the other."[1]

It would be childish to treat this kind of argument seriously. The mere fact that judges are only appointed from amongst the ranks of "first-class experts," or that "Christian Science" is not recognised as a legitimate qualification for the practice of medicine or surgery disposes of it.

Objection may well be taken to the introduction of politics into fishery questions, but when fishery interests are used as pawns in the party game it becomes necessary to record a protest.

The efficiency of the Central Department is essential for a resuscitation of the inshore fisheries, to say nothing of other vital needs in fishery administration, such as the codification and simplification of the salmon and fresh-water fishery laws or the proper application of scientific fishery research. What a capable public department can do when backed by intelligent support in the House of Commons may be seen by reference to the history of the rise of the great Scottish Herring Fisheries (Chapter V). Now, as then, it is not a case of a spasmodic effort, but of a carefully thought-out plan to be systematically carried on for a generation.

To secure this a capable staff is essential. That the Central Fisheries Department in England and Wales has been and still is understaffed is notorious, that questionable methods of filling vacancies have recently been adopted is perhaps not so well known.[2]

All those who have the interests of the sea fisheries of England and Wales at heart will welcome the creation of a strong, efficient and independent central department.

There remains the question of local fishery administration. This is practically non-existent in Ireland and Scotland, though in the latter country the Sea Fisheries Regulation Act, 1895, provides for the formation of district fishery committees. Up to the present no such committee has been established.

In England and Wales local fishery administration is carried out by Local Sea-Fishery Committees. The constitution and duties of these bodies are dealt with in some detail below (Chapter VII). It is unnecessary to recapitulate the arguments and conclusions arrived at with respect to these district committees, except to say that a strong case has been made out both for co-operation between the local and central authorities, and a considerable strengthening and extension of the powers of the former bodies.

[1] *Hansard*, 26th June, 1912, p. 378.

[2] See the evidence given by Sir T. Elliott, then Permanent Secretary to the Board of Agriculture and Fisheries, before the Royal Commission on the Civil Service.

So much, then, for administration What of scientific research, educational questions and the various other subjects which may be grouped together under the term " Reconstruction " ? Much will doubtless be heard in the few years after the war about the " Reconstruction " of the British sea fisheries The main lines which any scheme of reconstruction must follow in order to have any prospect of success are outlined below

"RECONSTRUCTION"

WE may start with the presumption that for purely administrative duties the present Central and Local Authorities will continue, though possibly in a modified form. For various problems arising in connection with the future of the Sea Fisheries the present organisation does not appear to be adequate, and some new controlling and co-ordinating authority is required. The question is, What is this new authority to be, and how will it best face the onerous duties which await it? Of all the Committees of Inquiry of recent years the problem seems to have been best understood by the Committee on Fishing Investigations of 1908, and in its recommendations is to be found the germ of the future organisation which must be established if the fisheries of these islands are to progress with the times. The first and by far the most important recommendation of the Committee of 1908 was, "The establishment of a Central Council for the United Kingdom which shall have control of public funds for Fishery Investigations of a National and International character." This recommendation is thoroughly sound, and until it is carried into effect the co-ordination of schemes for the improvement of the sea fisheries will prove to be impossible.

The Central Council should consist of a paid chairman and nine honorary members. The chairman should become a member of the Civil Service and should be appointed by the Prime Minister at a salary which should be sufficient to secure the best man available. Political or social considerations should not be allowed to influence this appointment, but the person selected should have experience in the following subjects: He should have a practical knowledge of the conditions under which the sea fisheries of this country are carried on, and should have had a thoroughly efficient training in scientific method, so that he may be able to form an independent and unbiassed opinion as to the value of any piece of scientific research, and its applicability to modern fishery conditions. If he also has a knowledge of fishery law and has had some administrative experience then so much the better.

The nine members of the Council[1] should receive only their

[1] See also "Memorandum on the Reconstruction of the Fishing Industry after the War," prepared by the Scottish Steam Drifters Association, Aberdeen, 1918. The scheme outlined above has been modified to bring it into line with the proposals contained in this Memorandum.

actual travelling and hotel expenses when engaged on the Council's work, and they should be nominated as follow —

One each by the Central Fishery Departments for England and Wales, Scotland and Ireland respectively Three in all

One by the Royal Society Presumably this member would also be a member of the Marine Biological Association of the United Kingdom, or, at least, be thoroughly conversant with its work

One by the National Sea Fisheries Protection Association Presumably this member would represent the great steam trawler companies

One by the Scottish herring drifters

One by the fish curing trade

One by working fishermen, a trade union member.

A Member of Parliament who should be selected by the Prime Minister, and be specially entrusted with the duty of advancing the interests of the inshore fisheries, or alternatively this last representative might be appointed by the Local Sea Fishery Committees of England and Wales at their Annual Conference

The duties of the Central Council should include —

(1) A quarterly meeting for exchange of views and discussion of problems arising from time to time

(2) The allocation of all funds voted by Parliament for fishery investigation (national or international) and development The money at present allocated by the Development Commissioners for fishery improvement should be handed over *en bloc* to the Fishery Council for distribution The Development Commissioners have already as much as they can successfully manage without being burdened with inquiries into various schemes of fishery research and improvement

(3) The publication of an Annual Report which should, *inter alia*, include —

(*a*) A statement showing the general trend of and progress accomplished by scientific research during the preceding year

(*b*) A statement showing the allocation of funds for fishery research and improvement during the preceding financial year

(*c*) A statistical statement showing the position of the sea fisheries of North-Western Europe during the period under review

(*d*) A summary showing the more important fishery developments in foreign countries

(*e*) Any other relevant matter bearing on the future of the fisheries that may be thought advisable

(4) Each central fishery department should prepare annually,

and submit to the Council a statement showing the chief lines of research proposed to be undertaken during the forthcoming year, together with an estimate of the cost of the same. The Council should review these statements and use them as a basis for allocation of the annual grants.

(5) The Central Council itself should not as a rule establish its own laboratories and undertake the direction of research. This should be left as at present with the Central Authorities concerned; but this should not be taken to mean that the Council would be excluded from calling for special investigations on certain points and appointing, paying and terminating the agreements with experts for these special purposes.

(6) The Chairman of the Council should satisfy himself that the staffing, equipment and situation of laboratories, including the laboratories of the Central Departments, applying for grants for scientific research, are adequate for the purposes of such research. He should personally, or through a duly qualified deputy, visit at least once annually such laboratories and report to the Council the result of his observations.

(7) Nothing in the foregoing shall be held to prevent the Council from itself drawing up schemes of investigation and forwarding the same to appropriate institutions for detailed research.

(8) The term scientific investigations shall in the above be held to include investigations into trade statistics. Greater uniformity in the publication of official fishery statistics should be arranged forthwith.

(9) The Central Council should have power to appoint trade agents (as is already done by certain foreign countries), either at home or abroad where such appointment is likely to advance the interests of the British sea fisheries.

(10) The Council should be consulted in all matters connected with fishery education, above the primary or elementary stage, this subject being dealt with in greater detail below.

(11) The Council should acquire a Reference Library on all matters of interest to the trade.

(12) The Council should have power to assist in the establishment of a permanent Fisheries Museum, in which should be deposited *inter alia* models of ancient and modern fishery apparatus, specimens of trade products and by-products. This museum should not only serve to interest and educate the public, but should also be of assistance to specialists engaged in fishery inquiries. The Chairman of the Council should, ex officio, be a member of the governing body of this museum.

Fishery Education

Before the war there were practically no special arrangements in Great Britain or Ireland for fishery education This statement, however, is not strictly accurate as regards Ireland (see p 187) The chaotic condition of the education of fishery circles will naturally be intensified when the new Education Acts for Scotland and England and Wales come into operation Although the Fishery Council can hardly be expected to take a close interest in the primary or lower secondary education of the fishery classes of the community, it ought to provide or take some steps to provide the necessary qualified staff which will be required when the great extension of education becomes an accomplished fact [1] The present position (or rather the pre-war position) will be seen on reference to Chapter X It would be absurd to describe these conditions as in the slightest degree satisfactory Not only is there practically no proper provision for the training of deep-sea or inshore fishermen to become better and more expert workmen, but the question of training (e g) persons engaged in the preparation of cured products or in the utilisation of by-products and waste in the fish trade seems never to have been considered

To go into elaborate detail at this stage either as to the duties of the Fishery Council in regard to scientific research or educational problems would be unwise, the general consideration of the functions and constitution of the Council would be lost in the criticism of points of detail

For this reason the outline given above with reference to scientific work was made as brief as possible, and one feels strongly inclined to make no further reference to educational matters

There are, however, two or three outstanding matters of urgency which must be referred to, and since the educational systems of Scotland and England and Wales are distinct, each may be taken separately

Commencing with Scotland where the fisheries play a relatively greater part in the life of the people than in England, the great outstanding necessity is an institution of University rank which should be devoted to the furthering of education and research in all matters connected with the sea and inland fisheries

It is with due diffidence that a Southron presumes to comment on Scottish educational matters, but, put briefly, the following seems to outline the main points for consideration

[1] The first course of instruction (in England and Wales) for intending teachers of fishery subjects was established in August 1919 by the Lancashire and Western Sea Fisheries Committee at their marine laboratory Piel Barrow in Furness

An institute of University rank should be established in Scotland, for choice affiliated to one of the existing Universities, say Aberdeen.

The management of this institution would naturally be left to the Scottish Authorities concerned, such as the University itself, the Scottish Fishery Board, the various trade authorities and local bodies engaged in or interested in fishery education. At this point one would make one proviso only, and that is that the Fishery Council should have direct representation on the governing body of the Fishery Institute, or whatever name may be decided on as most appropriate.

As to the curriculum, it would include ordinary instruction in technical and allied matters connected with all branches of the fish trade, such as the training of teachers for special schools and classes for the fishing sections of the community; courses of instruction in biological and hydrographical subjects affecting the growth, distribution and habits of sea and river fish; the chemical and bacteriological principles underlying the curing and preserving of fish (including canning and cold storage) and the utilisation of by-products. In fact, provision should be made not only for persons intending to become teachers in fishery schools, but those wishing to become officials of central or local fishery authorities engaged in administration or research, and also those who wish to become managers and directors of curing factories or cold storage plants.

In addition to this instruction, which would be given by men of acknowledged pre-eminence in their various subjects, the institution would fail unless provision were made for what one may term "post-graduate research"; and for this reason one would like to see the Fishery Institute established not only in close association with the University, but also with the main scientific laboratories of the Scottish Fishery Board.

In England and Wales though the problems to be faced are much the same, the prevailing conditions are somewhat different.

Immediate requirements would probably best be met by the establishment of a number (probably three would suffice at first) of technical fishery schools or colleges. Already at Grimsby and Hull the nucleus of a technical school exists, on the west coast Fleetwood has strong claims for consideration in this connection. The passing of the new Education Act will soon make the question of teachers an acute one, and one of the first essentials of the new Fishery Technical Schools is that they should be able to give special instruction, to persons who are already trained teachers, in such subjects as will enable them to take charge of special schools and

colleges and classes in *fishing localities* Up to the present the teaching of navigation in this country has been in the hands of retired seafaring men, and while one does not wish to decry their knowledge of their subject, it is obvious to anyone acquainted with educational matters that they would not be as capable as trained teachers of giving instruction in navigation and allied fishery subjects to the class of pupil who will be called into existence when the Education Act becomes operative

Towards the end of 1918 the steam-trawler-owners association (the National Sea Fisheries Protection Association) prepared a statement in which they advocate the formation of a separate Ministry of Fisheries with a separate Minister, presumably of Cabinet rank This statement, though in the nature of a summary, is far too lengthy to reproduce here At the same time, since it represents an important section of the fishing trade, indeed its advocates claim to be the trade, it merits careful consideration The memorandum would perhaps have gained in value had it been more judicial and less polemical, but that is by the way It is difficult to abstract what is really an epitome, and we have no desire but to present a fair résumé of the main features of the memorandum [1]

The steam trawlers claim that 82 7 per cent of the total catch of fish landed in the British Isles in 1913 was made by steam vessels, and that at least 94 per cent of the fish was caught outside territorial waters "Allowing for considerable underestimation of the inshore fisheries, they remain from a purely economic point of view—as a source of food supply—comparatively insignificant"

The National Sea Fisheries Protection Association believe that after the war there will be a great increase of fishing Large fishing grounds have been closed to fishing by Admiralty orders for a long period, and consequently it is reasonable to expect an accumulation of stock on these fishing grounds The Association, however, say that lean years may return, and no one who reads carefully *the fourth chapter of this book will deny this possibility* And it is against the prospect of these lean years that they wish to safeguard themselves

The Association say that the English and Scottish steam and motor vessels were worth twelve million sterling in 1913 Various members of the Association assess the capital invested in the British fisheries from fifty to two hundred million pounds This includes engineering shops, building slips, fishing docks and wharves, fish shops, fish markets, vessels, gear, canning factories, ice factories,

[1] Proposed Ministry for the Fisheries Memorandum prepared by the N S F P A Fishmongers Hall London 1918 (November)

curing and by-product factories. It is further stated that there were before the war 25,000 fried fish shops in the country which employed 50,000 persons and distributed 150,000 tons of fish annually, that is 18 per cent of the total fish consumption of the country. As examples, Bradford and Sheffield are given, in the former £8,000 and in the latter £20,000 a week are spent in fried fish shops ; " 560,000 square meals in two towns."

The Association appeal for State help in four main directions : Improved methods of capture, discovery and charting of new fishing grounds, industrial experiment and international research, the latter including the regeneration of impoverished grounds.

It is thought that the requirements of the fishing trade will best be met by the establishment of a Ministry of Fisheries, and previous suggestions for a National Fisheries Authority are quoted. But here the statements are of an *ex parte* nature, though as this question has already been fully dealt with in this book it is unnecessary to recapitulate the arguments.

The outlines of the Association's recommendations are :—

A Minister of Fisheries with a Chief Secretary. The Ministry to consist of eight main branches. Departments of Marine, Intelligence, Trade, Research, Industry, Finance, Training and Inland Fisheries.

The relations of this proposed new Ministry to existing organisations is not worked out fully ; but presumably the present Fisheries branch of the Board of Agriculture and Fisheries is to constitute the nucleus of it.

In short, the Fisheries branch of the Board is to be born again, and in the operation is presumably to acquire all those desirable qualities with which our second birth is associated.

At any rate, " Since the headquarters of the office would be in London the Service will not need any ' Board.' "

The Scottish Fishery Board is to be allowed to exist, but shorn of some of its attributes ; its officials will be endowed " with a channel for promotion into the Ministry itself." On the Irish side of the problem the Association have little to say. " Ireland may or may not find it to her advantage to come into the fisheries federation in the future."

It is doubtful whether the Scottish and Irish people are in favour of the concentration of fisheries administration in London. As to the Local Fisheries Committees in England and Wales, in the view of the Association, their day is past. " Local Government has, in fact, been tried and failed in relation to fisheries." " The Industry has outgrown the system and it should go." A fair summary of the views of the steam trawlers is that there should

be a supreme administrative authority for the fisheries with headquarters in London The Scottish Fishery Board would continue as an emasculated authority, and the Local Committees in England and Wales would be abolished Ireland can please itself The decision must naturally be left to the future, for the reasons set forth we think the scheme outlined on pp xxiii–xxv the best

Although we believe the European war will have no serious permanent effect on the British sea fisheries, it is useful to record the statistics of the fisheries during the war's duration

The following table affords a comparison of the year 1913 with the period 1914–18 It would require a special volume to give an adequate account of the rôle played by the fisheries during the war Most of the trawling grounds off the British Isles, including practically the whole of the North Sea, were closed to fishing by Admiralty orders At the close of the war no less than 3000 steam fishing boats were engaged in naval operations of one kind or another Practically all the physically fit fishermen of military age were similarly engaged, between 40,000 and 50,000 in all These were all trained and experienced seamen Many fishing vessels were lost in naval operations and many were sunk (or in the earlier phases of the war captured by the enemy) while peacefully engaged in fishing According to one official statement no less than 670 vessels were lost when actually engaged in fishing

Taking all this into consideration it is a matter for surprise that the sea fisheries of this country have been so well maintained

WEIGHT OF FISH LANDED IN THE BRITISH ISLES (TONS)

	1913	1914	1915	1916	1917	1918 [1]
England and Wales	807,600	506,240	284,255	212,209	202,580	234,048
Scotland	391,417	372,016	115,969	170,601	153,988	165,661
Ireland	33,820	29,494	27,509	28,300	33,137	31,387
Total	1,232,837	907,750	427,733	411,110	389,705	431,096

VALUE IN £'S OF FISH LANDED IN THE BRITISH ISLES

	1913	1914	1915	1916	1917	1918
England and Wales	10,337,000	7,846,687	7,391,067	7,222,965	9,151,636	14,147,844
Scotland	3,997,717	3,208,536	2,109,465	3,206,550	3,704,789	6,066,588
Ireland	294,625	238,635	334,443	444,929	646,003	880,197
Total	14,629,342	11,293,858	9,834,975	10,874,444	13,502,428	21,094,629

BRITISH ISLES

Average price per cwt. of fish

1913	1914	1915	1916	1917	1918
11/1	12/4	22/11	26/5	34/8	48/11

[1] The later figures are subject to revision. In 1918 the price of fish was fixed by Orders No. 39, dated 16 Jan., 1918; No. 323, dated 14 March, 1918; No. 529, dated 14 May, 1918, and No. 1203, dated 25 Sept., 1918.

THE SEA FISHERIES

CHAPTER I

STATISTICAL INTRODUCTION. THE COLLECTION OF STATISTICS

STATISTICAL evidence of the development of the British Sea Fisheries is to be found in the reports of the three Government Departments concerned with the administration of the fisheries. In England and Wales the Central Department is the Board of Agriculture and Fisheries, in Scotland the Fishery Board, in Ireland the Department of Agriculture and Technical Instruction.[1]

Each of these bodies publishes an annual report which contains *inter alia* a statistical review of the sea fisheries of the year preceding. Unfortunately there is no uniformity in the mode of presenting the statistical data, so that in comparing one country with another, or even in estimating the total value of the fisheries, care has to be exercised. It is a comparatively simple matter to add together the totals of the weight and value of the fish landed in each country, and in that manner to obtain some idea of the gross value of the British Sea Fisheries; but if any attempt be made to analyse the returns, the absence of any uniform system of recording the results of the fishing at once becomes evident.

In the official returns for England and Wales, fish are divided into "Wet" and "Shell." Wet fish are fresh, i.e. uncured sea fish. Shellfish comprise the various edible mollusca and crustacea, the former group including cockles, mussels and oysters, the latter crabs, lobsters, shrimps and prawns. In the Irish reports the divisions are "Fish" and "Shellfish," and these correspond to the wet and shellfish of the English reports. The classification of fish in Scotland is into herring, white fish (sea fish exclusive of herring) and shellfish. As fishing is now prosecuted from the Arctic circle to the tropics, and at depths from 5 to 200 fathoms, it will be readily understood that an enormous variety is available for the

[1] In congested areas in Ireland the Congested Districts Board is concerned with the administration, in some aspects at any rate, of the Sea Fisheries.

markets of the British Isles On hawkers' carts in our industrial centres, together with the ubiquitous herring and mackerel, may not infrequently be seen specimens of deep water Salmonidæ (Argentina) from the West of Ireland, horse-mackerel (Carangidæ) from the Bay of Biscay, cat-fish (*Anarrhichas lupus*) from northern waters, or even Sciænoids from the African coast [1] Occasionally, fish are landed from remote grounds which turn out to be unmarketable, and among these may be mentioned the ribbon-fish (Trichiuridæ) or Centriscidæ of southern waters, or Chimæra from the Irish coasts [2]

In the annual reports of the Board of Agriculture and Fisheries there are thirty-four different kinds of wet fish enumerated, including whitebait, which is not a distinct species, but usually a mixture of the young of the herring and sprat Most of the names are familiar enough, though Latchets or Tubs (a species of gurnard) and Torsk or Tusk (a member of the cod family) will be strange to many Of shellfish the only three kinds separately enumerated are crabs, lobsters and oysters

Wet fish are further divided into demersal, those living on the sea bottom, and pelagic those living at the surface and intermediate depths To the latter class belong herring, mackerel, pilchards and sprats, the other fish being demersal The statistics for England and Wales for 1913[3] show there are fifteen species, the annual value of which exceeds £100,000 each Of these two only—herring and mackerel—are pelagic, the remainder, cod, ling haddock, coalfish plaice, dabs, hake, soles, halibut, turbot, skates and rays, whiting and lemon soles being demersal Of Scottish fish the pelagic herring is easily first, its value for 1913 being over £2 000,000, haddock (£549,711), cod (£583 451) and halibut (£111,549) are the most important demersal species The total value of sea fish landed in Ireland is, as a rule, about £300,000, The question naturally suggests itself, How does the yield of the fisheries compare with former years? Unfortunately, with the exception of Scotland, reliable fishery statistics are not available over any extended period, but a rough comparison is possible between the present day and 1885 Early in 1885, in pursuance of the recommendation of the Statistical Inquiry Committee and of a general desire to the same effect, the Board of Trade commenced the collection in a systematic form of statistics of fish caught and landed on the English coasts Up to

[1] The writer has also seen specimens of Hoplostethus and Trachyrhynchus exposed for sale in Preston

[2] See The Scarcer Fishes in Aberdeen market by D Arcy Thompson *The Scottish Naturalist* October 1917

[3] On account of the outbreak of war the statistics for 1914 and subsequent years are abnormal

that time the fishery statistics of the British Isles had not been collected in a systematic manner with the exception of Scotland. It is doubtful whether the returns for England, Wales and Ireland are even approximately correct for 1885, but as that was the year in which the first attempt was made to give an official return of the value of the fisheries the figures are quoted.

1885. WEIGHT AND VALUE OF FISH LANDED IN BRITISH ISLES[1]

	Weight (tons).	Value (£).	Average (£).
England and Wales . .	320,000	3,957,000	12·4 per ton
Scotland	236,000	1,476,000	6·3 ,,
Ireland	24,000	643,000	27·0[2] ,,
Total . . .	580,000	6,076,000	

Broadly speaking, the weight of fish landed in the British Isles in 1885 was, exclusive of shellfish, estimated at 600,000 tons. The latest returns of sea fishing in a normal year are those for 1913, from which it will be seen that in thirty years the weight and value of sea fish landed in the British Isles has more than doubled.

1913

	Weight (tons).	Value (£).	Average (£).
England and Wales . .	807,600	10,337,000	12·8 per ton
Scotland	391,417	3,997,717	10·2 ,,
Ireland	33,820	294,625	8·8 ,,
Total	1,232,837	14,629,342	

A question of considerable interest is that which concerns itself with the number and kind of vessels comprising the British sea fishing fleet, together with the men who form the crews of these vessels. Every fishing boat engaged in commercial sea fishing from the British Isles should be registered, and should bear, when in commission, conspicuous letters and numbers, the former denoting the port of registration. Fishing boats are supposed to conform to certain detailed instructions which need not be quoted as to registration, lettering and numbering, but in England and Wales, at any rate, there was, prior to the war, and had been for years, considerable laxity in the enforcement of these regulations.

For the above purposes fishing boats are divided into three classes. First-class boats include all steamers of 15 tons gross

[1] For Sea Fishery statistics of Europe see, von Montlong, " Beiträge zur Statistik der Seefischerei in den wichtigsten Staaten Europas," in the *Statistische Monatschrift* for 1905, Wien; and also the publications of the International Council for the Exploration of the North and neighbouring Seas.

[2] Obviously overestimated.

tonnage and upwards and all boats (other than steamers) of 15 tons register tonnage and upwards Second-class boats include all steamers of less than 15 tons gross tonnage, and all boats (other than steamers) of less than 15 tons register tonnage, or of 18 ft keel and upwards Third class boats include vessels under 18 ft keel other than those navigated by oars only This system of classification was no doubt an excellent one fifty years ago but the enormous growth in recent years in size variety and number of vessels in the first class renders some subdivision imperative before any proper classification of sea fishing boats can be made Classes two and three are now negligible if one considers merely the gross value and weight of fish landed in these islands as their contribution to the total must be an extremely modest one but if one considers that these boats furnish either a temporary (seasonal) or permanent livelihood to a large number of men then they cannot be left out of consideration

In 1883 the fishing fleet of the British Isles[1] was constituted as follows —

	First class Steam	First class Sail	Second class Sail
England and Wales	181	3 562	4 881
Scotland[2]	40	3 984	8 808
Ireland	4	512	3 675
Total	225	8 058	17 364
		8 283	

The tonnage of the 225 steamers aggregated 6654 tons giving an average of about 29 5 tons per steamer The first-class sailing boats 8058 in number represented a tonnage of 224 097 tons an average of 27 8 tons per smack The second class boats 17 364 in number, aggregated 83 464 tons an average of 4 8 tons per boat

The latest pre war returns of the fishing fleet show as might be expected a remarkable increase

SUMMARY OF FIRST CLASS FISHING VESSELS (1913)

	Steam Vessels Trawlers	Steam Vessels Liners	Steam Vessels Drifters	Sailing Vessels Trawlers	Sailing Vessels Liners	Sailing Vessels Drifters
England and Wales (including Isle of Man)	1 363	66	671	817	38	192
Scotland	298	884		—	1 692	
Ireland (1912)	14	?	?	391		

[1] Registered under the Sea Fisheries Act 1868 on 31st December 1883
[2] But see *Annual Report Fishery Board for Scotland* for 1883

THE SECOND AND THIRD-CLASS BOATS

	Second.	Third.
England and Wales	Steam 205	1,960[1]
	Sail 3,603	
Scotland	2126 (sail and oars)	2,944
Ireland (1912)	2693	1,185

In England and Wales in 1913 there were 1359 steam trawlers with an average (net) tonnage of 74·7 tons, the first-class sailing trawlers numbered 822 with an average tonnage (net) of 34·7 tons.

In Scotland the fishing vessels are somewhat differently classified. In 1913 the total number of vessels was 8991 with a tonnage of 136,905. For years the number of vessels has decreased, but, nevertheless, the tonnage has increased, showing that a larger and more powerful vessel is being adopted. In 1887 there were 15,135 boats and vessels engaged in the Scottish Sea Fisheries, and the estimated capital invested in the boats and vessels, nets and gear was £1,712,349. In 1913 the number of the steam, sailing, motor boats and vessels engaged in the Scottish Fishing industry was 8991, of a value including nets and gear of £6,035,952.

An estimate of the number of men and boys actually engaged in fishing from ports in the British Isles is given in the following table. The census return of fishermen is notoriously incomplete, as no attempt was made at the last census to obtain returns from fishing boats which happened to be at sea when the census was taken, and since the sea is the normal habitat of the deep sea fisherman it follows that a very large number must have escaped enumeration.

BRITISH ISLES. ESTIMATED NUMBER OF FISHERMEN, 1913

	Regularly employed.	Occasionally employed.	Total.
England and Wales	37,442	7,362	44,804
Scotland	29,822	4,682	34,504[2]
Ireland	7,852	11,162	19,014
Isle of Man	428	150	578
Channel Isles	504	126	630
	76,048	23,482	99,530

Only in Scotland is an attempt made (in the fishery returns) to estimate the total number of persons employed in fishing and the various industries subsidiary thereto. In 1913 the total was 90,710. Of these 38,262 manned[3] the fishing fleet; 16,269 were gutters and

[1] In 1911.
[2] From a return published by the Board of Agriculture and Fisheries.
[3] From a return published by the Scottish Fishery Board.

packers of herring and 14 560 were engaged in the carrying trade The remainder were engaged in other work connected with the fishing industry. As to the value of the fishing fleet, here again the only estimate furnished is that for Scotland The total value of the boats and gear engaged in the Scottish sea fisheries during 1913 was £6,035,952 Of these the steam fishing vessels (excluding trawlers) were valued at £2,051,980 and their gear at £343 632 The fishing boats and vessels propelled by sails and oars (excluding trawlers) were estimated to be worth £439,947, the nets £291,355 the lines £44,380; the bush and buoy ropes, and stoppers £98,695 Crab and lobster creels are worth £12,035 The total under this heading therefore accounts for £886,412 Motor fishing vessels and gear account for £206,535 The beam and otter trawl vessels propelled by steam were valued, together with their gear, at £1,320,430, and those propelled by *sails at* £2550 Full *details of* the boats belonging to the various fishing ports are given in the official returns The value of the curing yards and other premises connected with the Scottish fishing industry is estimated roughly at £1,500,000 *Of this total* about £400,000 is attributed to herring curing, which, it should be noted, does not call for any elaborate or expensive accommodation, £115,000 to whitefish (such as haddock) curing premises, £200,000 to ship and boat-building yards, and £160,000 to net and other gear factories, the remainder being represented by ice and manure factories

Although no attempt is made in the official fishery statistics for England to estimate the value, and the number of persons engaged in, the fish-curing trade, it is possible to arrive at some conclusions from the census returns [1] In 1907 the gross output was £3 636 000, the materials used costing £2,863 000, the net output being therefore £773,000 Of this Scotland claimed £2,277,000 gross and £483 000 net, England and Wales £1,308,000 gross and £278,000 net, and Ireland £51,000 gross and £12,000 net England ordinarily employs 6603 wage-earners and 284 salaried persons, 2723 being males and 4164 females; Scotland, 16,769 wage-earners and 448 salaried persons, 3775 males and 13,442 females, Ireland 560 wage-earners and 20 salaried persons, 197 males and 383 females The net output per person, £31, is very low, but it must not be forgotten that the curing season is a short one, and but few persons are engaged throughout the whole year

There were ten fishing ports in England and Wales at which over 200 000 cwt of sea fish were landed in 1913

Grimsby, 3,584 616 cwt, *Yarmouth*, 3,140,884, *Lowestoft*,

[1] Census of production Preliminary tables summarising the Results of the Returns received under the Census of Production 1906 Part VI Cd 5463 1911

2,439,515; Hull, 1,607,648; Billingsgate, 964,620; North Shields, 923,074; Fleetwood, 745,632; Milford, 492,327; Hartlepool, 251,493; Blyth, 222,845.

In Scotland the fishery statistics are published separately for twenty-seven districts. Of these, eight yielded returns of over 200,000 cwt. of sea fish in 1913:—

Aberdeen, 2,151,952 cwt.; Peterhead, 805,885; Shetland, 771,694; Fraserburgh, 681,088; Stornoway, 606,212; Wick, 454,480; Leith, 346,372; Orkney, 340,194.

Fish was practically the only pre-war foodstuff exported[1] from the British Isles, and the extent of this branch of the trade is probably not generally appreciated. The total quantity of fresh fish and shellfish exported in 1913 was 1,464,296 cwt., valued at £1,212,493; in 1912 the weight was 1,402,778 cwt., value £1,197,521. The weight of cured fish exported in 1913 was 9,530,407 cwt., valued at £6,288,608; and in 1912 9,130,407 cwt., value £5,523,978.

Of the fresh fish exported the great bulk is herring, the weight of this fish being for 1913 no less than 1,163,334 cwt., value £585,738. Of this the greatest quantity (1,111,790 cwt.) went to Germany. The Netherlands and Belgium come next, but are far behind the German total. Over 40,000 cwt. of both cod and haddock were exported fresh, the greater part going to Germany and Belgium. Over 15,000 cwt. of fresh mackerel and 6700 cwt. of salmon (fresh) were exported, the major portion of which went to France and Belgium.

Of the cured fish no less than 8,797,106 cwt. were herring, the average price per cwt. of which was 12·1 shillings. Of this fish Germany took nearly 4 million cwt., Russia coming second with over 3½ millions. There is a big drop to the next country, the United States, which took from us a little over 400,000 cwt. in 1913. Italy, which takes principally red or smoked herring, imported from us 91,590 cwt., and New Zealand, which prefers the tinned variety, 11,656 cwt. Greece took 42,169 cwt., mostly smoked, and Australia 71,655 cwt. (mostly tinned). The immense distribution of British herring all over the world can only be realised by consulting the detailed lists. In Africa they went not only to British possessions, but to Liberia, the Congo Free State, Abyssinia and the Portuguese and former German colonies. In Asia they reach Siberia, India, China, Japan, Ceylon, Burma, the Straits Settlements, the Malay States and Java. They have formed an important item in the author's dinner at a dâk bungalow in the wilds of Bengal.

They go to Hawaii, Papua and the various Pacific Islands, and to nearly all the South American States.

[1] See Appendix, p. 275.

Next to herring the most important dried or cured fish is cod In 1913 the exports of cured cod amounted to 441,969 cwt, value £601,914 The great market for dried cod is Spain, which took 182,061 cwt in 1913 The next most important markets are Cuba and Brazil, which took 46,553 and 31,596 cwt, respectively, in 1913 The quantity sent to Brazil shows a decline in recent years, as both Newfoundland and Norway are forcing their dried fish on the Brazilian market

Cured haddock to the amount of 33 793 cwt were exported in 1913 the Australian colonies being our best customers

Cured mackerel, of which nearly 100,000 cwt are exported annually, goes mainly to the United States, but there are fair markets in Turkey, Canada and the British West Indies The United States took nearly 89,000 cwt in 1913

Pilchards are essentially an export, and 37,033 cwt went abroad in 1913 The great market for these fish is Italy (32 850 cwt), but a few are sent to Brazil, the United States, the Cape of Good Hope and India

THE COLLECTION OF STATISTICS

For many years the collection of fishery statistics in England and Wales was woefully inadequate, and in spite of the statement of Mr Runciman,[1] then President of the Board of Agriculture and Fisheries, that " our fishery statistics are much better than those of any other nation," there is room for considerable improvement, and the Board have a lot of leeway to make up before they can hope to compare their statistics with those of the Scottish Fishery Board

The earliest fishery returns for the British Islands were simply returns of the quantity of fish conveyed inland by railway from each of the principal fishing ports, and the first such return was for the year 1878 In 1885 the Board of Trade began the collection, in a systematic form, of statistics of fish caught and landed on the English coasts These statistics were published annually under the title " Statistical Tables and Memorandum relating to the Sea Fisheries of the United Kingdom, including Return of the Quantity of Fish carried by Railway from each of the principal ports of England and Wales, Scotland and Ireland during the years from to inclusive "

These returns were long known to all serious students of the sea fisheries to be inadequate both in plan and extent, and even as far

[1] Address delivered to the 24th annual meeting of representatives of authorities under the Sea Fisheries Regulation Act 1888 Thursday June 25th 1914 Cd 7557 P 7

as they went both incorrect and inaccurate. The position was summed up accurately by Mr. Holt in 1895[1] when he wrote: "It appears to be the peculiar function of the Fisheries Department of the Board of Trade to formulate statistics which shall be just sufficiently complete to bring into strong relief the importance of what is omitted from them."

In June, 1896, the naturalists on the staff of the Marine Biological Association of the United Kingdom prepared a report on Fishery Statistics for the information of the Council of the Association. This report showed that the official statistics were defective in the following respects:—

I. The discrimination between the species of fish landed is imperfect.

II. The results are given in weights and values; nothing is said of numbers and sizes.

III. The results are arranged according to the localities where the fish are landed; nothing is said of the locality of capture.

IV. The statistics given concerning boats and men employed are inadequate for the purpose of showing the condition and history of different branches of the industry.

V. No separation is attempted of the products of different methods of fishing.

In 1900 a Board of Trade Committee was appointed to inquire into the system of collecting fishery statistics in England and Wales, and to report how the system could be improved and extended, and what additional cost (if any) would be entailed thereby, having special regard to the opinion expressed by the Select Committee of the House of Commons on Sea Fisheries, 1893, and the proposals of the Stockholm Conference, 1899. This Committee reported in 1901, but its recommendations were not put into force immediately. In fact, it was not until 1906 that there was any marked improvement in the official returns. During the previous year (1905) improvements in the collection of statistics were gradually effected in four directions.

Considerable progress was made towards obtaining complete accounts of the results of each voyage of every first-class trawler and liner landing fish at the various ports on the east coast; this method of collection was extended to similar vessels landing fish at ports on the south and west coasts; a commencement was made towards obtaining detailed returns of the locality of capture of herrings, mackerel, pilchards and sprats, and finally the number

[1] "An examination of the present state of the Grimsby Trawl Fishery, with especial reference to the destruction of immature fish," by E. W. L. Holt, *Journ. M.B.A.*, N.S., III, 1893–5, p. 339.

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Pilchards are essentially an export, and 37,033 cwt went abroad in 1913 The great market for these fish is Italy (32,850 cwt), but a few are sent to Brazil, the United States, the Cape of Good Hope and India

THE COLLECTION OF STATISTICS

For many years the collection of fishery statistics in England and Wales was woefully inadequate, and in spite of the statement of Mr Runciman,[1] then President of the Board of Agriculture and Fisheries, that " our fishery statistics are much better than those of any other nation," there is room for considerable improvement, and the Board have a lot of leeway to make up before they can hope to compare their statistics with those of the Scottish Fishery Board

The earliest fishery returns for the British Islands were simply returns of the quantity of fish conveyed inland by railway from each of the principal fishing ports, and the first such return was for the year 1878 In 1885 the Board of Trade began the collection, in a systematic form, of statistics of fish caught and landed on the English coasts These statistics were published annually under the title ' Statistical Tables and Memorandum relating to the Sea Fisheries of the United Kingdom including Return of the Quantity of Fish carried by Railway from each of the principal ports of England and Wales Scotland and Ireland during the years from to inclusive '

These returns were long known to all serious students of the sea fisheries to be inadequate both in plan and extent, and even as far

[1] Address delivered to the 24th annual meeting of representatives of authorities under the Sea Fisheries Regulation Act 1888 Thursday June 25th 1914 Cd 7557 P 7

of kinds of fish separately distinguished in the returns was increased by the addition of bream, coalfish, dogfish, dory, mullet and pollack

In 1905 the statistical returns were designed to show —

(1) The annual changes occurring in the total quantity and value of fish landed, distinguishing the quantity taken "within" from that taken "beyond" the North Sea (2) The annual changes in the quantities of the two principal classes of fish landed at various ports (3) The monthly changes in the quantities of different kinds of fish landed throughout the year

In 1914, in addition to the collection of statistics of the quantity and value of fish landed, the Board of Agriculture and Fisheries were engaged in the collection of statistics relating to the distribution and size of sea fish, the variations in their abundance and their place of capture A series of samples of certain kinds of fish are also weighed and measured by the officers of the Board at certain important ports Plaice were the fish first dealt with in this manner, then haddock, and finally cod The main object of this statistical work is—apart from the acquisition of information regarding quantities and value of fish landed—to determine the variations in the abundance and distribution of food fish, and the effect of different methods of capture with a view to determining whether the stock is decreasing, and to form a basis for estimating the effect of possible protective measures, as well as of determining what protective measures are required and where

In 1913 the Board employed eight whole time officers seventy private persons, eighty four coastguard officers and one customs officer as Collectors of Fishery Statistics The expense of collection including the ichthyometric statistics, was £3245 Each collector is required to enter daily the total quantity and value of each kind of fish landed at his station (Form A) On the first day of each month he has to add up the quantities and values entered on Form A during the previous month The totals are entered on another (Form B) Both forms are then to be sent to the Board Separate records are made in respect of each voyage of every first-class trawler and liner (Form D2), and also (Form D3) daily of the total quantity of herring, mackerel, pilchards and sprats, that is the pelagic fish landed at each station Forms D2 and D3 are forwarded weekly to the Board The Board has no compulsory powers to make fishermen or fishing vessel owners give accurate returns There are no statistics for England and Wales for cured fish During the war the detailed forms (A and B) which were very elaborate and wasteful of paper, were withdrawn and simpler forms substituted In March 1919, the Board of Agriculture and Fisheries published a list of Collectors of Fishery Statistics The names of

two Supervising Collectors appear in this list, which shows that returns are obtained from 157 fishery ports in England and Wales.

Any statistical account of the fisheries of the waters of North-Western Europe which leaves out the operations of foreign fishing vessels is certain to be one-sided. Taking pre-war figures (for 1912) for the fisheries of the Western and Northern states of Europe, including the Baltic, but excluding the French fisheries in the Mediterranean, we get the following table :—

YIELD OF THE SEA FISHERIES NORTH-WEST EUROPE (1912)[1]
(IN THOUSANDS OF CWTS.)

	North Sea only.		All areas.	
	Quantity.	Per cent.	Quantity.	Per cent.
Belgium	145	0·6	258	0·46
Denmark	386	1·7	1,218	2·19
Faroe	—	—	295	0·53
Iceland	—	—	1,708	3·07
Finland	—	—	208	0·37
France	—	—	3,437	6·18
Germany	1,480	6·4	3,293	5·92
Great Britain	15,723	68·2	24,073	43·28
Holland	2,276	9·9	2,302	4·14
Norway	2,915	12·6	16,019	28·80
Russia	—	—	445	0·80
Sweden	130	0·6	2,373	4·27
	23,055		55,629	

[1] *Fish Trades Gazette*, 20th October, 1917, p. 25.

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CHAPTER II

METHODS OF FISHING

THE evolution of modern methods of sea fishing from the primitive methods of our ancestors has yet to be described

The earliest accounts of methods of sea fishing of any value are those in Diderot's Encyclopédie (1751–77) and by Duhamel,[1] who has written an interesting and well-illustrated account of the sea fisheries of the eighteenth century, more particularly of France and the French colonies The early forms of trawl, drift-net and trammel are figured and described, and there is a full account of the methods of catching and curing cod on the Grand Banks of Newfoundland and the coast of Labrador The chief defect in this work is the absence of any adequate reference to, or description of, the deep-sea herring fisheries, which, however, were not participated in to any extent by the French

Other accounts of methods of sea fishing, illustrated with drawings of boats, nets and gear have been published, for Ireland, by Brabazon,[2] in 1847, for the British Isles, by Holdsworth,[3] in 1874 and for the beam trawl fishery of Great Britain, by the United States Fish Bureau in 1887[4]

Modern methods of catching sea fish on a large scale fall naturally into one of three sections (1) A method involving the use of a movable or drag net, the highest modern development of which is the so-called otter trawl (2) A method involving the use of a fixed or floating net, the most effective of which is the drift-net, employed in modern steam fishing boats It will readily be understood that in the first method the net encircles and captures the fish, whereas in the second the fish swim into the net and are en-

[1] *Descriptions des Arts et Métiers faites ou approuvées par messieurs de l Académie Royale des Sciences de Paris* Nouvelle Edition Tome V *Contenant les trois premières sections du traité des pêches et l histoire des poissons* Neuchatel 1776 Tome X *Contenant les deux premières sections de la seconde partie du Traité des pêches* Neuchatel 1779

[2] *The Deep Sea and Coast Fisheries of Ireland* Dublin 1847 See also a report by Capt Washington on the Loss of Life and Damage caused to Fishing Boats in the Gale of August 1848 for numerous drawings to scale of contemporary fishing boats Priuted by order of the House of Commons July, 1849

[3] *Deep Sea Fishing and Fishing Boats* London 1874

[4] *Fish Bulletin* 1887

meshed in it. (3) The third method involves the use of baited hooks attached to lines. Although there are other methods of fishing for sea fish, e.g. trammel-nets, stake-nets, they are negligible as a means of supplying the great fish markets of these islands. Consequently fishermen may be divided into trawlers, drifters and liners, and since the interests of these three classes is to a great extent opposed, it is found that the history of the sea fisheries records a good deal of friction between the various groups, and this has not been without effect on legislation. Not so very long ago the fisherman of our coasts did not devote himself exclusively to any one branch of his calling, but the coming of steam and the capitalist changed things in a remarkable manner. The village fishermen, a favourite theme with poets and artists, who for the most part owned their own fishing craft and who fished in the immediate proximity of their native place, are rapidly disappearing. In their place we have the paid " hands "[1] forming the crew of the steamer owned by the limited liability company. This deck-hand or " deckie," with his incongruous attire, the most conspicuous items of which are a " bowler " hat and clogs, has usually no more seamanship than a cowboy. No painter has yet limned his features, and it would need a resuscitation of Pietro Aretino to reproduce his language in its comprehensive lewdness.

In 1885 the bulk of the fish consumed in the British Isles or exported from our shores was caught either in the North Sea or in the immediate neighbourhood of our coasts by sailing vessels, and by men who owned or had a pecuniary interest in the vessels they manned. These men followed various branches of fishing. Since 1885 the gradual ousting of sail by steam has taken place, and simultaneously the area of exploitation has been considerably extended. As Prof. D'Arcy Thompson[2] puts it, " The industry as a whole tends towards concentration, to the use of larger boats, to the need of greater harbours ; tends, in the case of line and trawl fishing, to gravitate towards the great centres of population and the great highways of traffic." One of the results is that nowadays sea fishing is a highly technical occupation, so much so that a fisherman is usually only acquainted with one method of fishing and often with only a particular part of that method. On modern steam fishing vessels it frequently happens that the master alone knows how to navigate the ship and to manipulate the gear—the " hands "

[1] Not infrequently a 'nigger,' 'Dutchman,' or 'Dago.' Witness the consternation in steam trawling circles (December, 1914) caused by Admiralty order forbidding employment of aliens on British fishing vessels.

[2] Paper read before the Royal Institution of Great Britain by Professor D'Arcy W. Thompson, C.B., M.A., " The North Sea and its Fisheries," March 22nd, 1912, p. 12.

merely obey his commands But there are still 6000 small fishing boats in England and 8000 in Scotland, and about one seventh or one-eighth of the 35 000 fishermen in Scotland, and a somewhat larger proportion of those in England still live on the produce of the inshore fisheries "They are the fishers of crab, and shrimp and lobster, the hand line fishers of plaice and haddock and codling, the men who take, now and then, a day at the lines, a night at the herring, the dwellers in the antiquated harbours and in the tiny creeks of outlying coast and distant island The kindliest of Scotch proverbs tells us that 'it takes all sorts to mak' a world,' and these men have their claim on us and their right to live "[1]

As a result of the passing of the fisheries into the grip of the capitalist there is a gradual disappearance of the coastal fisherman In order to understand the present position it is necessary briefly to consider the different classes of fishermen and the way they have been affected by modern developments

Broadly speaking, the fisheries and fishermen of the British Isles can be divided into three main groups In the first place there are the great steam fisheries Trawling, lining and drifting are carried on by means of large and powerful vessels owned for the most part by limited liability companies with ample capital This method of fishing involves the use of large quantities of consumable stores, such as coal, oil and ice Further, good harbours accessible at all states of the tide, and provided with ample quay space, railway sidings, dry docks or patent slips for repairs are indispensable In many cases the development of these steam fisheries is fostered by the railway companies, whose harbours they use

Secondly there are the deep-sea sailing fisheries These comprise both trawlers and drifters, and both classes have been much affected by the steamers In England there are very few ports remaining where sailing vessels of this class predominate; but the deep-sea sailing trawler still holds its own at Brixham and Ramsgate Practically the only advantage which the sailing vessel possesses is the small working expense involved, more particularly when the skipper has a direct pecuniary interest in the profits Some vessels of this class, especially the drifters, may benefit by the adoption of some type of marine motor Motors would prove to be time savers in going to and returning from the fishing grounds, as they could be used in calm weather and would frequently save a tide, often a vital consideration in reaching the market in the case of a perishable commodity like fish Although most sailing trawlers now carry ice for the preservation of their catch, the time saving element is still of importance The importance of seamen of this type to the

[1] Thompson, *op cit*

nation is self evident, and in both Scotland and Ireland, as will be seen, efforts have been and are being made which, without unduly interfering with other classes of fishermen, should secure for them reasonable conditions of existence.

Thirdly there are the inshore or coastal fisheries carried on almost exclusively inside the territorial limits, partly by landsmen or longshoremen ignorant of the intricacies of boat handling, partly by real seamen whose management of their open or half-decked boats commands the admiration of everyone who has come into contact with them. These men form the lifeboat crews at most of the stations. This class of fisherman does not come into direct competition with the steamers, though the increase of steam trawling in confined waters may produce a permanent diminution of the stock of fish he has to depend on. His chief enemy is the middleman, the so-called " Commission Agent." An appreciable percentage of the earnings of the inshore fisherman is derived from the capture and sale of shellfish. To this fact and to their remoteness from the great markets is due their escape from extinction. Often the fishermen themselves or their wives and children hawk the fish in the neighbouring towns and villages. " Pleasure sailing " in the summer months and the letting of apartments to visitors are additional sources of livelihood to these men.

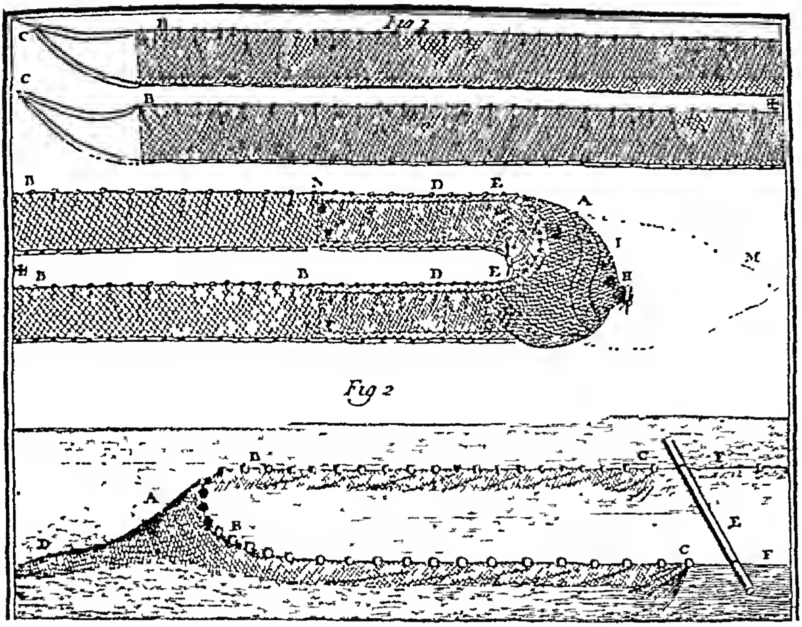
The two chief methods of catching demersal sea fish are by means of a movable or drag net, and by baited hooks attached to lines. Both these methods have been in use from time immemorial. In certain countries, e.g. England, the most modern form of drag-net, the trawl, has superseded the method of catching fish by hooks and lines, at any rate for commercial purposes; but there are still localities, e.g. certain parts of Scotland and the Grand Banks of Newfoundland, where line fishing is the chief method employed for the capture of demersal fish. It would be interesting, but hardly practicable in a work of this scope, to trace fully the evolution of the trawl from its ancestor the seine. The seine, which is still used in the coastal fisheries, is a semicircular drag-net which is " shot " in such a way as to enclose an area of water close to the shore. One end of the net is attached to a rope, held by a man stationary on the beach, the net being paid out from a boat which returns to the shore at the time the other end of the net is reached. The obvious defects of the net are that it only fishes through a very limited portion of water and it can hardly be used except in shallow water close inshore. It is true that the net has been adapted for fishing away from the shore, in which case two boats were employed. The first improvement in the semicircular seine and the first step in its evolution into a trawl was the insertion of a sleeve or pocket

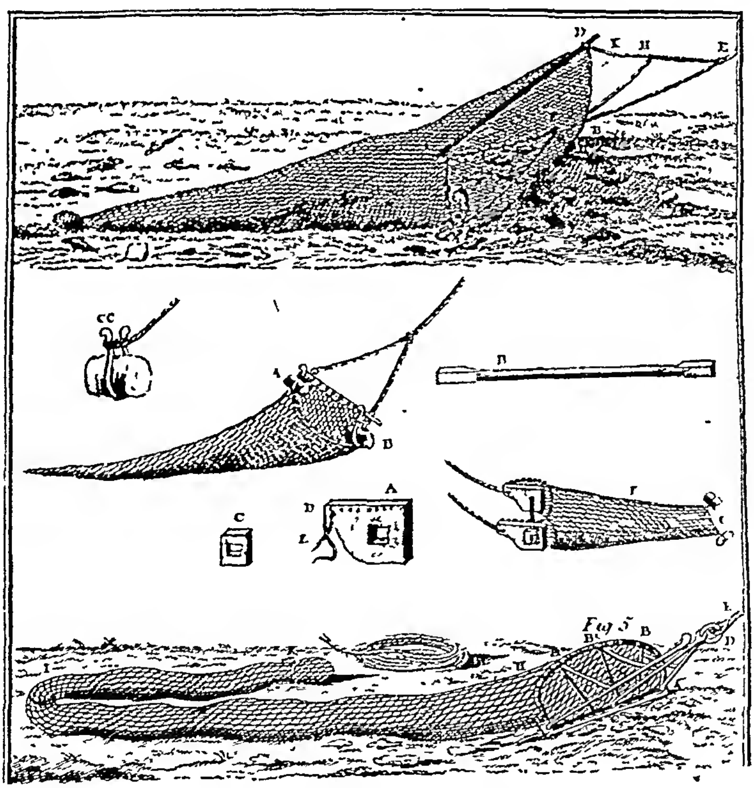
in the terminal portion and the elongation of the wings Seine nets of this description have been known for centuries and are met with in all parts of the world The Bara-jal of the Telugu fishermen of Puri is a net of this species The "Aissaugue" of the French Mediterranean coast of the eighteenth century may be taken as a type of this first stage in the development of the trawl (see Fig 1, p 16) In this net the pocket (AH) corresponds to the cod-end of the trawl, and the wings (BB) to the similarly named part in the trawl

The "Aissaugue," though an improvement on the ordinary seine, could, nevertheless, only be used at a moderate distance from the shore (three-quarters of a league, more or less) The net was shot from two boats, dragged slowly to the shore and then hauled in just like the seine Sardines were the principal fish caught by this method The chief objections to this net were that it could only be used in shallow water and required two vessels to work it satisfactorily

The great difficulty in using a seine as a drag-net from one vessel lies in keeping the mouth of the net open Eventually some genius discovered that it was possible to do this by tying the ends of the net to a beam of wood This type of net is seen in the eighteenth-century "Gangui" of Narbonne, Cette and other towns of Languedoc (Fig 2, p 16) The pocket or cod-end is now more elongate (AD), and the wings (BC) shorter than in the Aissaugue The primitive beam (E), which was affixed when it was proposed to use the net from a single boat, was a pole of 3 fathoms length, firmly attached near each end to the top fore end of the wings (C) The warps (F) used for hauling the net were 7 fathoms long In contrast to the modern beam trawl there were two complete warps attached to the port and starboard sides of the vessel, which could only forge ahead under full sail The net was weighted with 80 or 100 lb of lead and dragged along the bottom In fishing, the vessel comes up to the wind, the rudder is unshipped, the net thrown overboard, the cod end first, then the wings, finally the warps are payed out, their extremities being made fast to the vessel The nets are buoyed so that they may be recovered in case the warps break The Gangui was capable of being hauled in board with the aid of a winch (Treuil) and it was no longer necessary to run the vessel ashore to complete the operation of fishing A further stage in the evolution of the trawl is seen in the nets used in Normandy, Brittany and other parts of the French coast, *circa* 1776

One of these was known as the "Chausse" or Chalut (Poitou) (Fig 3 p 16) In this net the mouth had at the bottom a strong rope (AB) corresponding to the foot-rope of the modern trawl This rope was furnished with leaden weights to keep it on the bottom





EVOLUTION OF THE TRAWL.

Fig. 1.—The Aissaugue of the Mediterranean. Fig. 2.—The Gangui of Languedoc.
Fig. 3.—The Chalut of Poitou. Figs. 4 and 5 —Trawls of Brittany.

LOADING HERRING FOR EXPORT

The upper opening of the net was fastened to a beam (CD) of light wood, such as the fir. To the extremities of the beams bridles (CE, DE) were attached. The mouth of the net was kept open by warps or ropes (AF, BH) running from the extremity of the weighted foot-rope to a point from one-third to one-half the distance along the bridles. From the point of junction of the bridles a warp ran to the vessel. The resemblance to the modern beam trawl is now fairly close, except for the absence of the trawl-heads, which must have made this net a rather awkward one to handle, even though it was customary to fasten a large stone at the points A and B. This net was used to capture flat-fish which were stirred up out of the sand by the foot-rope. One method of fishing this net was to sail out from the shore to a distance determined by the length of the warp. The net was then shot and the vessel returned to the shore, the net being subsequently hauled in in a slanting direction so as to cover as much ground as possible. This net, though shaped like a trawl, was fished like a seine.

Still closer approximations to the modern beam trawl were in use by the eighteenth-century fishermen, both in England and France. In one type (Fig. 4, p. 16) the modern trawl-head or trawl-iron was represented by knee-pieces of wood (AB) bent into the shape shown in the illustration. In these knee-pieces one or more stones were placed, serving to sink the trawl to the bottom. In the latter half of this century the fishermen of St. Brieuc (near St. Malo) used a superior kind of trawl (Fig. 4, p. 16) in which the trawl-heads were wooden frames attached in the manner shown. Each head was bracket-shaped (A), the beam (B) stretching between them. The beam was fixed in the trawl-head by means of a perforated stone (C), which served as a sort of ballast. At the point (D) of the trawl-head there was a projection to which the bridle was attached. The base of the trawl-head was rounded so that it would move more easily over the sea-bottom. It will be noticed that in this trawl the head-line is not laced up to the beam, but curves backward a little and is provided with cork floats. This net was intended for the capture of bottom-living fish, both flat and round, and to assist in this pockets were laced in on either side at the point marked F. These pockets extended from the trawl-heads for nearly three parts of the length of the trawl. The cod-end was rather broader than in the present-day trawl, and to either end a small rope with a stone was attached to keep the net spread out on the bottom.

The most elaborate of these older trawls was one in which the opening was secured by means of an iron framework, similar to that now used in an oyster dredge, except that it was much larger, extending up to 14 ft. in length (Fig. 5, p. 16). Instead of a foot-

rope there was a blade of iron (AA) The whole frame consisted of a bent piece of iron (AB, BA) attached to the warp by three iron rods (AD, CD), of which two were fixed to the extremities and one to the middle of the bottom iron bar For strengthening purposes there were cross-pieces of iron (G) running from the base to the top of the frame and from the top of the frame to the middle of the iron rods (AD, CD) The net itself was 5 or 6 fathoms long (HIK), to protect it part of an Irish bullock's hide (LL) was attached on the surface near the trawl frame This net was used in water from 7 to 8 fathoms deep, either by day or night and all the year round, except during the mackerel season When used from a sailing boat it was customary to attach a small warp to the trawl warp and carry it to the opposite side of the ship to which the trawl warp was attached Sometimes two of these nets were used simultaneously from the same vessel Usually the net was hauled after being dragged for a quarter of a league, in order to clear the net which was found to be full of seaweed stones, oysters and other débris

The trawl is one of the most important implements of fishing The trawl net may be described as a conical bag of netting dragged along the bottom of the sea Many people seem to think that a sailing vessel or steamer is stationary whilst engaged in trawling but that is not the case The vessel moves ahead at a slow rate of speed, from two to six miles an hour, dragging the trawl astern There is evidence that British trawling originated in Devonshire, most probably at Brixham The old fashioned type of trawl net, and that still used by smacks and cutters, was attached to a beam of wood to either end of which a triangular iron frame was in turn affixed The upper end of the net is attached to a head rope which is laced up to the beam The lower margin of the net is attached to a much heavier rope, the foot rope, which curves back widely between the bases of the trawl heads When fishing, the whole arrangement is dragged along by two ropes, the bridles, which are in turn shackled to the single trawl warp leading to the vessel In the net itself there are traps or pockets which prevent, or at any rate hinder, the egress of the fish It is obvious from this description that the trawl will only capture such fish as live on or near the sea bottom, and these are the demersal fish of the official returns In addition to fish, any other objects lying on the sea bottom are captured by the trawl For instance, star fish and other invertebrates are frequently taken in great abundance A small trawl with a fine mesh is a favourite device for the capture of shrimps

Trawling for fish or shrimps from a small inshore cutter is generally conducted on similar lines If the vessel about to shoot the trawl be on the starboard tack, the cod-end of the net is first thrown

overboard, and then the body of the net; when this is stretched out the beam is lowered over the side, the bridle next the stern having been previously taken round to the port side of the cutter. The peak of the mainsail is then lowered and the vessel runs down before the wind to bring the bridles even. The course is now held on until sufficient trawl warp has been paid out for fishing, the warp is then made fast forward. The amount of warp paid out depends on circumstances such as the nature of the ground and the strength of wind and tide. When the net is shot on rough ground or where there are obstructions, such as rocks, derelict anchors or wrecks, precautionary measures are taken to prevent the trawl being lost. A short piece of rope, called a stopper, is made fast to the vessel's gunwale, and the other end of the stopper is fastened to the trawl warp. The stopper is weaker than the trawl warp, possessing only sufficient strength to drag the trawl over the ground. When the trawl meets an obstruction the stopper breaks, and the loose trawl warp commences to run out. The helm is now put down immediately so as to bring the vessel's head to wind as soon as possible; this stops her way and saves the trawl or, at least, gives a chance of saving it, since the cutter can now be hove up to the trawl by the trawl warp. When hauling under ordinary circumstances the head sail is lowered and the vessel luffed up to the wind, the trawl warp is then hauled in over the bows until the bridle is reached. One end of the bridle is now passed aft, both ropes are then hauled in together until the beam is at the surface of the water. It is then hove in over the gunwale, made fast temporarily, and the net hauled in by hand.

In modern steam trawlers the beam-trawl is replaced by a much more effective instrument—the otter-trawl. In this instrument the beam is omitted and the heads are replaced by two large boards, the "otter" boards. These are shod with iron and are somewhat larger and much heavier than ordinary house-doors. One great advantage of the otter-trawl is that the width of the mouth of the net can be greatly increased.

The ponderous and clumsy beam is replaced by a strong head-rope. The net is kept open by the reaction on the pair of boards. Each board, and consequently each end of the net, is attached to the steamer by a separate warp.

A pre-war type of steam trawler would be a large and powerful vessel of most excellent sea-going qualities. Since the outbreak of war vessels of even larger type have been built, but the details of their structure are not yet available. A pre-war steam trawler would be of about 123 tons net tonnage or upwards, with engines of 80 or more nominal horse-power and would cost at pre-war rates from

£6000 to £7000 to build For convenience of fishing a steam trawler carries two trawl nets ready for instant use, one on either side of the ship When on the fishing grounds, fishing is continuous, the duration of a haul is from five to six hours, and as soon as the net is hauled and cleared it is shot again Trawling is possible at depths from 5 to 200 fathoms, except where the bottom is very rocky Beyond 100 fathoms trawling is not at present practised extensively for commercial fishing As a rule a steam trawler carries nine hands, consisting of the skipper, mate, boatswain, two deck hands, cook, two engineers and a fireman The larger vessels which make longer voyages carry additional hands Payment is partly by wage, partly by share

The tendency in recent years is for the design of steam trawlers to become adapted for a special kind of fishing A steamer working the North Sea grounds and landing her fish at Grimsby would be designed on different lines to a Fleetwood trawler working the Iceland grounds, or a Swansea trawler destined for Moroccan waters Consequently a general description will not apply in all respects to any particular boat, though there is naturally an agreement in broad outlines The text figures show a longitudinal section and the deck plans of a steam trawler In the older type of trawler the master and all hands were accommodated in a small cabin aft, but in the more recent types the living accommodation is distributed as shown Forward of the after cabin are the engine, boiler, stokehold and main bunkers Practically all the larger vessels have a spare bunker filled with coal on the outward voyage, but capable of being washed out and used for storing fish on the return journey Forward of this is the main fish hold, loosely divided into divisions or pounds by detachable boards fitting athwart ships fore and aft, and shipping into stanchions the full depth of the ship Each pound is divided horizontally by a number of shelves on which the fish, mixed with ice, is laid The two forward pounds are filled with crushed ice before the vessel leaves port Forward of the ice-room is the store room with racks for the nets, ropes and other gear, and in the later ships a forecastle with accommodation for about eight men On deck aft there is generally a house on the extreme stern, which serves as a storeroom and also for protection of the lifeboat, usually fitted on the top of the cabin skylight In more modern trawlers there are two lifeboats slung from davits on either side, just abaft the funnel Forward of the cabin skylight come the galley and the entrances to the cabin and engine-room Forward of this is a skylight with the casing over engines and boilers Then come the funnel and forward of it the bridge with wheelhouse, and in the later types the skipper's cabin

Immediately forward of the bridge on deck is the powerful steam winch used for shooting and hauling the fishing gear. This winch usually weighs 8 or 9 tons, and has two large drums, each capable of holding from 1000 to 1500 fathoms of steel warp. The main deck forward of the winch is divided into pounds by boards about 2 ft. high, and into these the fish are emptied out of the net, sorted out, washed and gutted before being stowed away below in ice in the fish-hold. In the larger trawlers a whaleback about 6 ft. high is fitted right forward, serving as a cover for the steam windlass used for heaving up the anchors, and also as a protection for men working on deck, as the rounded form of the whaleback throws off any heavy water and keeps the deck comparatively dry.

The earlier steam trawlers were from about 85 to 100 ft. long, and were fitted with compound engines of low power, the bunker capacity being from 50 to 70 tons, and the fish-carrying capacity from 15 to 20 tons. To-day the steam trawler may be anything from 110 to 175 ft. long and provided with triple-expansion engines. Many of the larger vessels have a bunker capacity of 250 tons with a fish-carrying capacity of from 50 to 60 tons.

Longitudinal Section Through a Modern Deep-Sea Trawler

(Illustration, p. 22)

Total length, 160 ft. Length between perpendiculars, 148·5 ft. Greatest breadth (frame), 23 ft. Draught, 13¾ ft.

Explanation of plan

1. Wheelhouse. 2. Captain's cabin. 3. Collision bulkhead. 4. Crew's quarters. 5. Store for gear, nets, etc. 6. Chain locker. 7. Fish-pounds (on deck). 8. Fish-hold. 9. Cross bunker (for coal). 10. Main bunker. 11. Passage to bunker. 12. Steam-winch. 13. Stokehold. 14. Lifeboat. 15. Triple expansion engines (650 indicated h.p.). 16. Bathroom. 17. Mate's quarters. 18. Dining-room and berths for engineers. 19. Storeroom.

A Modern Steam Trawler

Plan of arrangements on and below deck

I. On deck.—1. Winch. 2. Hatches. 3. Gallows. 4. Bollards. 5. Fish-pounds. 6. Steam-winch (for trawl). 7. Blocks. 8. Officers' messroom. 9. Galley. 10. Ventilators. 11. Funnel. 12. Bunker-hatches. 13. Engine-room skylight. 14. Bathroom. 15. Mate's cabin. 16. Lifeboat.

II. Below deck.—1. Collision bulkhead. 2. Crew's quarters. 3. Storeroom. 4. Iceroom. 5. Fish-hold. 6. Reserve coal bunker. 7. Main bunker. 8. Side bunkers. 9. Stokehold. 10. Main pump.

11 Auxiliary pump 12 Engines 13 Dynamo 14 Cabin 15 and 16 Chief and second engineers quarters

The cost of building and equipment vary much, but a concrete example of the state of affairs a few years ago may not be devoid of interest Such a vessel as that figured (see Figs p 22) would have cost £9800 to build, and her fishing equipment, including from four to six trawl nets and six otter boards, £600 This vessel usually travelled at 11 knots, and when so travelling consumed about 11½ tons of coal daily The coal consumption during fishing operations amounted to about 10 tons daily Her bunker accommodation was 235 tons

This trawler fished from January to March off the coast of Morocco the fishing voyages lasting twenty days, the catch being preserved in ice and landed in a fresh condition, this being almost without exception the British custom Sixty tons of ice were required on these voyages, and this sufficed for 35 tons of fish

From March to June the Iceland salt cod fishing was followed a class of fishing almost entirely in the hands of foreigners The duration of the voyages in this case was six weeks this fishing being followed by a three months' journey (from June to October) to the Banks of Newfoundland, also for cod For the salt cod fishery 100 tons of salt were required and in the fish room accommodation was found for 800 barrels, none being carried on deck From October to December steam trawling was carried on in the English Channel and the Bay of Biscay, the fish being landed fresh from ice Such a trawler would cost (in 1909) about £9000 a year to run The actual earnings of a vessel of this type are given from 1st February to the 3rd November —

Three voyages to Morocco	£2 808
Iceland	£2 280
Newfoundland	£3 040
English Channel (six voyages)	£2 576
Total	£10 704

The otter trawl net is attached to the boards on the bottom by means of a very heavy foot rope (G R) and above by the head line (H L) the latter taking the place of the beam in the older beam trawl The head line is much shorter than the foot rope, the latter curving out to a marked degree towards the tail-end of the net This deep curve is termed the bosom The lateral portion of the net between the head line and the foot rope is the wing Inside the net a trap or pocket is inserted The cod-end is opened and fastened by the cod line

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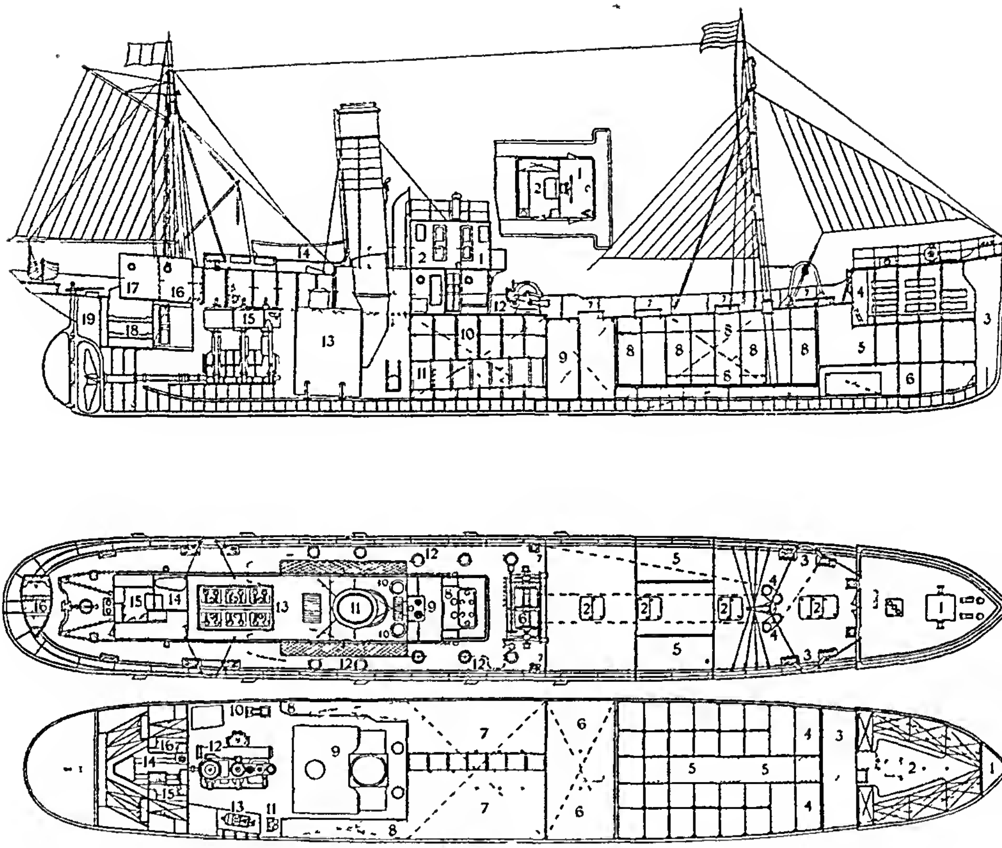


MODERN STEAM TRAWLER.
Plans and Section (*Details in text.*

Fig 1

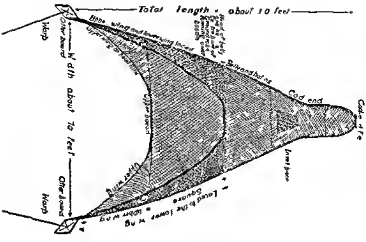


Fig 2

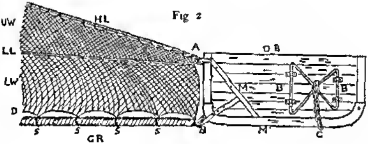


Fig 3

THE OTTER TRAWL

Fig 1 —The otter trawl

Fig 2 —Attachment of board to net OB otter board B iron brackets C chain to connect with warps M metal strengthening pieces M′ iron shoe HL head line UW upper wing LW lower wing LL lacing connecting wings GR ground rope D balch of lower wing SSS twine settings connecting balch to ground rope A head line and lacing connected to board by shackle. B toe of ground rope connected to board by shackle

Fig 3 —Bosom of a bobbin foot rope for use on rough ground A B balch line on head of belly and connecting with bosom of wings SS wire settings connecting balch to small intermediate bobbins 6″ diameter (E E) Large bobbins up to 24″ diameter F F

The boards measure from 8 ft. by 4 ft. to 10 ft. by 5, according to the size of the trawler. They are fitted one on each side of the back of the net, at the same point as the trawl-heads in the beam-trawl. They are so balanced that they move forward on their longest edge, each diverging at angles of about 20 degrees, keeping the mouth of the net open to its full extent. The point at which the trawl-warp is attached to the board has been determined as the result of experience; it can also be determined by hydrodynamical calculations. The point of attachment is generally about one-third of the length of the board measured from the fore end and rather below the mid line. The size of the head-line and foot-rope and the diameter of the meshes of the net vary considerably, and depend on the kind of fishing undertaken. The otter boards weigh from 800 lb. to 1000 lb., each is secured and towed by a separate steel warp, having lengths varying from 600 to 1000 fathoms. When fishing on rough ground the foot-rope is furnished with large, heavy wooden rollers, the "bobbins."[1]

Attempts have been made, particularly on the Continent, to design vessels which can be used alternately for trawling and drifting. These vessels do not seem to appeal to the British section of the steam fishing trade, so a very short description of a vessel of this type must suffice. There are certain difficulties to be faced at the outset. In the first place the screw or propeller must be protected by a cage of iron rods. In addition there is a rudder situated forward in the space marked (4 in Fig. of long. section), to facilitate the handling of the ship when the drift nets are being shot.

Longitudinal Section Through a Trawler Drifter

(Illustration, p. 24)

1. Wheelhouse. 2. Chartroom. 3. Captain's cabin. 4. Fore-rudder. 5. Crew's quarters. 6. Water tank. 7. Storeroom. 8. Gallows. 9. Iceroom. 10. Fish-hold. 11. Shelves. 12. Water ballast. 13. Support for lowered mast. 14. Net room. 15. Space for warps. 16. Entrance to water ballast. 17. Spare bunker. 18. Main bunker. 19. Stoke-hold. 20. Engines. 21. Engineer's quarters 22. Storeroom.

A recent type of trawler-drifter would be of 156 ft. length, 23 ft. beam and a register tonnage of 325 tons. On her trials the engines developed 727 indicated h.p., the speed being 12 knots. Under ordinary circumstances the steamer would develop 650 indicated h.p.

[1] For additional details see Kyle, "Fishing Nets, with Special Reference to the Otter Trawl," *Journal Marine Biological Association*, Vol. VI, N.S., p. 56?. Plymouth, 1900–3.

and a speed of 11 knots on a consumption of 10½ tons of coal per day. The bunker capacity would be 150 tons. The plans above and below deck are shown in the illustration.

PLANS OF TRAWLER DRIFTER

I. Deck plan.—1. Gangway to forecastle. 2. Hatches. 3. Mast. 4. Gallows. 5. Fish-pounds. 6. Steam-winch. 7. Captain's cabin. 8. Ventilators. 9. Bunker-hatches. 10. Funnel. 11. Gratings. 12. Engine-room skylight. 13. Lifeboat. 14. Galley. 15. Lifeboat. 16. Cabin skylight.

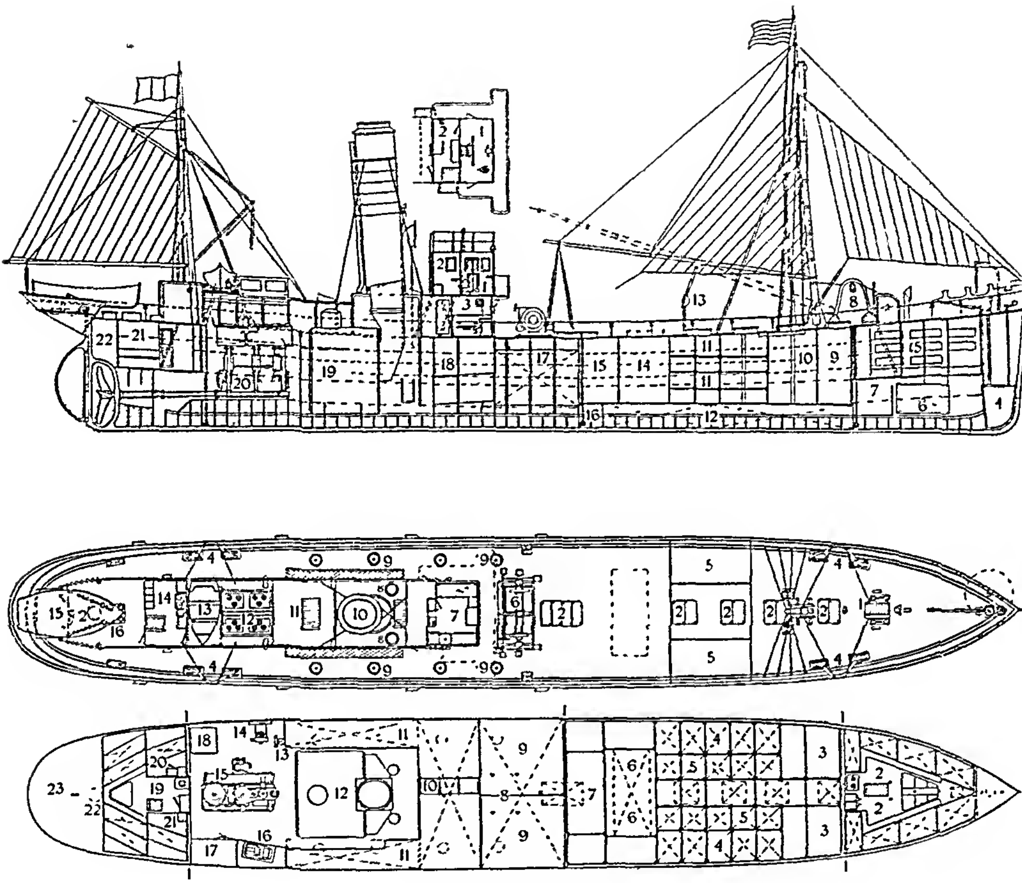
II. Plan of arrangements below deck.—1. Watertight bulkheads. 2. Crew's quarters. 3. Iceroom. 4. Shelves. 5. Fish-hold. 6. Net room. 7. Room for warps. 8. Wooden bulkhead. 9. Reserve bunkers. 10. Passage way. 11. Coal bunkers. 12. Stoke-hold. 13. Auxiliary pump (donkey pump). 14. Main pump. 15. Engines. 16. Dynamo. 17. Storeroom. 18. Fresh water tank. 19. Dining-room. 20. Cabin. 21. Chief engineer's cabin. 22. Deck hatch. 23. Storeroom.

The sailing trawler of the present day falls into two main groups; the first-class "Smack" making voyages of five or six days' duration and fishing in depths of from 5 to 40 fathoms, and the second-class cutter, which rarely stays out for more than twenty-four hours, working usually within the territorial waters. The trawling smacks are two masted vessels with fore-and-aft rig (see Fig. p. 25).

The deep-sea smacks are fast dying out, and only at Ramsgate, Brixham and in the Irish Sea are they holding their own. The Irish Sea smacks originated from Hoylake, and in the year 1880 the fleet there was probably at its best. The apprenticeship system was not much in vogue, and boys went to sea as cabin boys at twelve years old. For three years they acted as learners, afterwards getting half a share for a year and then a three-quarter share. At seventeen or eighteen years a lad could reckon on getting a full share as a member of the crew.

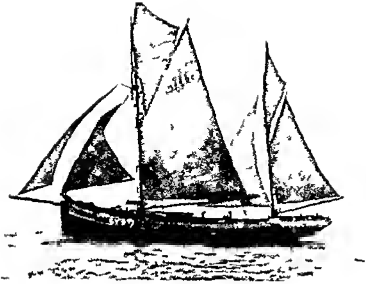
The class of boat fishing at that time from Hoylake was ketch-rigged, with a length of keel of 48 ft. and tonnage from 38 to 40. These boats were specially built at Whitehaven and in the Isle of Man, so that they could take the ground in the "Hoylake" which at that time had not silted up. They had good, long, flat floors, rather full forward, but with a clear run aft. They were good sea boats, sailed well, and were well adapted for dragging a trawl.

At about this time there were still a few smack-rigged boats, but those that were suitable for conversion into ketch-rig were altered. A few years later new boats were built for the Hoylake fishermen

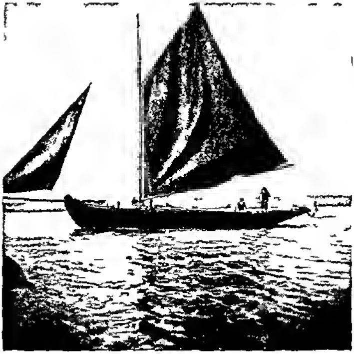


A TRAWLER-DRIFTER.

Plans and Section. (*Details in text.*)



A SAILING TRAWLER (First class)



A SAILING TRAWLER (Second class)

at Fleetwood, Freckleton (near Preston) and Brixham. All were ketch-rigged. The sails were made locally by a sailmaker and they were—particularly the mainsail—of very heavy canvas (No. O Hemp) and coated after one winter's wear with red ochre and linseed oil. Spars and small repairs were also attended to locally.

The length of trawl beam was from 50 to 54 ft., it was of greenheart, the trawl heads or irons weighed from 8 to 10 score pounds. These were made by the local blacksmith. The trawl warp and bridles were of tarred manilla.

The owner, who was responsible for the upkeep of the boat and gear, took two and a half shares, the other four shares going equally between the men, who settled with the boy at the end of each trip. The boy generally got a shilling a week from each man, or after an unusually good trip one shilling and sixpence. The whelks were the perquisite of the boy and the oysters of the men. The day was divided into four watches, two floods and two ebbs. A dark ebb and flood and a moonlight flood and ebb were distinguished, and in the dark tides most soles were caught. After the net was shot and the fish cleared away (from the previous haul) the crew went below for a meal, previously prepared by the boy, and at this time the boy was left alone on deck. Hauls were made at high and low water.

The most flourishing period of the Hoylake fishery was between 1885 and 1895, when about forty boats fished from Hoylake.

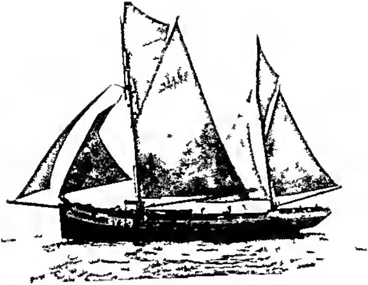
Afterwards the "Hoylake" began to silt up rapidly and many of the younger men went into the steam trawlers. The boats of this fleet now remaining fish from the Mersey.

The net was of hemp, the meshes at the tail or cod end being 4½ in. measured round the four sides of the square to about 7 in. at the top of the net. In winter a much smaller mesh was occasionally used for whiting. The nets were made locally. Usually an old retired fisherman knitted the back, for which he received a pound sterling. The other portions were made by the crew; the skipper knitted the wings, the mate the belly or 9-score piece, the third hand the 7-score piece and the fourth hand the 5-score piece.

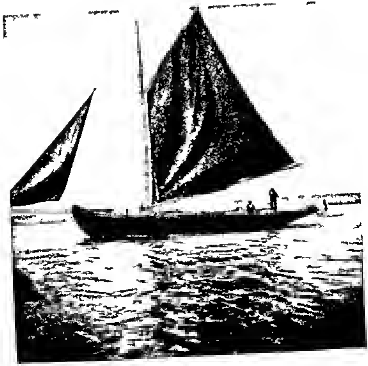
The net was preserved with coal tar. In the older boats there was a double purchase winch fore side of the mast as well as an after winch for heaving up the after part of the trawl.

These boats were, as a rule, splendidly built, and the writer has seen one at work a hundred years after it was launched.

Gradually a steam capstan superseded the winch for the purpose of hauling in the trawl. It was first introduced about 1890, and consisted of a compact perpendicular boiler fixed fore side of the



A SAILING TRAWLER (First class)



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crew's cabin, the steam being carried under the deck to a capstan fitted near the main hatch abaft the mainmast

The grounds fished were Liverpool Bay (in summer), off the Isle of Man, all along the Welsh coast in Carnarvon and Cardigan Bays and the Bristol Channel (Tenby grounds) Occasionally visits were made to Donegal Bay, and the grounds between the Calf of Man and the Irish coast were also fished The mainstay of the fleet were soles and plaice, though cod and ray were at times important

Almost all the men were natives of Hoylake Each boat carried four men and a boy, and the earnings were divided into six and a half shares

Attempts have been made from time to time to compare the relative efficiency of the sailing and steam trawler

In a paper on the impoverishment of the sea, Garstang, in 1900,[1] took the first class sailing trawler as the unit of catching power For some time after the introduction of steam trawling, the vessels employed were small, of low engine power and the beam trawl was used The catching power of these early steam trawlers with the beam trawl was estimated at from three to six times that of the smack[2] Garstang estimated that during the period 1883–5 the steam trawler caught about four times as much fish as the smack After 1885 the steam trawlers increased rapidly in size and efficiency, and the introduction of the otter trawl in 1895 marked a great step forward, so that the older comparisons were no longer admissible Garstang gives a table showing the relative efficiency of the steamer as compared with the smack advanced from fourfold in 1884 to eightfold in 1898[3] In 1901 Fulton[4] compared the relative efficiency of the beam and otter trawls as used from steamers, and found that the latter was 1 37 times as efficient as the former Similar experiments were carried out by the Marine Biological Association on the *Huxley* with the general result that the otter trawl caught 47 per cent more than the beam trawl[5]

More recently Miss Lee[6] has made a comparison of the catching power of various types of fishing boats She compares small steam trawlers with the Lowestoft smacks, Lowestoft small steam trawlers

[1] *Journal of the Marine Biological Association* Vol VI N S p 44
[2] Report Select Committee on Sea Fisheries 1893 See answers to questions 351 1165 and 4119
[3] Op cit p 48.
[4] *Annual Report Scottish Fishery Board* Vol XX Part III
[5] North Sea Fisheries First Report Southern Area 1902–3 Cd 2670 —1905
[6] Comparative notes on various trawler catches in the North Sea including some steam trawler records for 1903 and 1905 by Rosa M Lee M B A International Investigations Fourth Report Southern Area Cd 6125 London 1912 p 291 Also Review of Commercial Trawler Statistics Relating to Plaice by Rosa M Lee Board of Agriculture and Fisheries Fishery Investigations Sea Fisheries Vol II No 5 London 1915

and Dutch steam trawlers, Lowestoft small steamers and the Grimsby steamers, and finally the Grimsby and Dutch steamers. Her conclusion is that " when the otter and beam-trawls are used on a modern steam and sailing vessel, respectively, we find that the former may take as much as eight and a half times the amount of plaice and two and a half times the amount of soles." All these comparisons though interesting are of doubtful utility. There are so many factors to be considered that it is extremely likely that no comparison is possible. In the first place the steamer can fish in many places which are absolutely impossible for the smack, owing either to the distance from the home port, the depth of water or the rocky nature of the bottom. The heavy bobbins used on the foot-rope of the modern steam trawler enable it to fish on " hard " ground which is quite hopeless for the sailer. Even if the comparison be made for grounds available to both types it is still a difficult matter to arrive at a numerical ratio which shall express the relative efficiency of the two types. The steamer can fish in weather when it would be dangerous for the sailing boat to leave its moorings, and *per contra* in very calm weather when the latter vessel lacks the power to enable it to drag its trawl over the bottom of the sea. Moreover, to compare the efficiency of these vessels from the fishing results of a very limited number, or of only one of each type, leads to another point which will be obvious to anyone having practical acquaintance with sea fishing operations, and that is the personal factor. Some skippers will make a respectable living on the same ground where other men would starve. On the whole it is not advisable to place too much reliance on any of the above comparisons. From personal experience the author believes the modern steam trawler is many times more efficient than the smack than the highest of the above ratios would seem to indicate.

A typical second-class trawling cutter (see Fig. p. 25) would be of the following dimensions, length 42 ft., beam 12 ft. with a draft of 5 ft. 6 in. The stem, sternpost, deadwoods and timbers are usually of British Oak, the keel of American rock elm, the planking of pitch pine, and the decks of best yellow pine. The spars comprising mast, boom, gaff, jib-boom and topsail yard are usually of Oregon pine or selected spruce. The rigging is of best ploughed steel wire, the forestay, topmast stay and topsail halyards of best flexible steel wire. The price of an inshore cutter in 1914 would vary with size and other requirements from £160 to £210.

Naturally there are considerable variations in the trawling gear used by vessels of this type, though there is a general agreement in main outline. A Lancashire cutter of the type illustrated would carry a trawl beam of from 26 to 30 ft., but if engaged to any extent

near the surface. It is carried on by sailing vessels and steamers. The drift net is supported on a line carrying cork floats, which is in turn attached to ropes and buoys supporting the net at a varying depth from the surface. Briefly the drift net is a completely submerged vertical wall of netting.

The third principal method of fishing is chiefly practised in Scotland, where a considerable quantity of demersal fish is caught by means of long lines, attached to which are baited hooks. Here, as elsewhere, this kind of fishing is falling off. A long line may be as much as 7 miles in length; at regular intervals pieces of line from 2 to 3 ft. long, the "Snoods" are attached and these snoods carry the hooks. The line is usually shot at night and fished in the morning, its position in the sea being marked by buoys. The statistics of white fish fishing in Scotland illustrate in a remarkable manner the gradual supplanting of line fishing by the steam trawler. In 1894 the catch of line fish amounted to 1,400,000 cwt., of trawl fish 1,700,000 cwt. In 1904 the totals were line fish about 754,000 cwt.; trawl fish, 1,705,000 cwt. In 1913 the total quantity of line-caught fish landed in Scotland was almost exactly the same as in 1904, but in the meanwhile the quantity of trawl-caught fish had gone up to 2,542,000 cwt.

It must not be forgotten that it is largely as a measure of protection to this and other classes of inshore fishing that the policy of closing Scottish waters to trawling has been advocated for many years by the Scottish Fishery Board. The number of resident fishermen on the shores of the Moray Firth, which may conveniently be taken as an example, fell from 12,000 in 1892 to 10,261 in 1906. Taking the districts Fraserburgh to Wick, inclusive, the totals for 1910 correspond very closely with those for 1906. For the whole of Scotland the line fishing continues to show a decline, though this is somewhat retarded, presumably because the fishermen are introducing internal-combustion engines into their boats and thus increasing their sphere of activity.

A steam drifter is usually a vessel of 90 ft. length, with a beam of 18½ ft. and a draught of about 10 ft. From the deck of the vessel rise two pole masts, from each of which a small sail can be stretched; the foremast can be lowered when the vessel is steaming against a head wind or is engaged in fishing. The vessel is divided into water-tight compartments and is usually provided with acetylene gas for lighting purposes. The engine is of the compound surface-condensing marine type, a speed of from 10 to 11 knots being developed. Such a vessel would cost in 1914 from £3500 to £4000, and its fishing equipment from £750 to £800. The sailing drifter of Scotland is being rapidly replaced by steamers of this type. Of

in shrimping the beam would be of 25 ft only, in order to comply with the by-laws Sea fish nets and shrimp nets are interchangeable on beams of 25 ft and less With a beam from 25 to 30 ft the trawl-irons or trawl heads would weigh from 36 to 45 lb each, the lighter iron being used for shrimping Flax or cotton is used for the nets, which are preserved before use by tanning or tarring The beam is of greenheart or lancewood, the qualities looked for being weight and strength The beam is usually in three parts, the middle piece being much the longest

In a shrimp iron the length would be 1 ft to the bend, the height 10 in, the length of sole and bend 18 in In a fish trawl iron the dimensions are sole 2ft to bend, sole and bend 2 ft 8 in, 16 in in height, and 10 in from eye to beam

In a beam-trawl of 40 ft from head to head the height of the irons would be 3 ft, the net would be 70 ft measured over the back and 4 to 5 ft wide at the cod end The trawl bridles would be about 15 fathoms each, and to this a trawl-warp of 150 fathoms is shackled With a sailing trawler, trawling is always with the tide, against it the net could not be kept on the ground

In a second-class cutter with a net of 26 ft beam the following are the dimensions in the case of a Fleetwood boat —

At the top of the back of the net, near the head line, 14 score meshes, of $1\frac{1}{4}$ in from knot to knot The total length of the foot-rope $10\frac{1}{2}$ fathoms, length of back of net 50 ft, length of belly from hinder end of foot-rope to cod end 25 ft or 26 ft The width of the net at the hinder end of foot-rope is 7-score and 10 meshes, at the cod-end 40 meshes The hinder end of the pocket, inserted in the net, is 15 meshes across [1]

These nets can be worked on muddy or sandy grounds, or where the bottom consists of sand and shells Weed and stones are both objectionable Every skipper holds his own opinion as to the best method of fishing Probably some will agree with me that on a good trawling ground with a breeze 4 on Beaufort scale at a depth of 6 fathoms it would not be far wrong to pay out 25 fathoms of warp in addition to the bridles, at 10 fathoms, 50 fathom of warp could be used As the breeze freshened more warp would be paid out

The trawl catches any species of fish living on or near the sea bottom The second chief method of fishing—drift netting—on the contrary is only designed to catch one species, usually either herring or mackerel, and that not on the bottom, but while swimming

[1] There is an interesting account of the method of knitting a trawl net in Notes on Nets, or the Quincunx practically considered by C Bathurst pub Van Voorst London N D See p 92

near the surface. It is carried on by sailing vessels and steamers. The drift net is supported on a line carrying cork floats, which is in turn attached to ropes and buoys supporting the net at a varying depth from the surface. Briefly the drift net is a completely submerged vertical wall of netting.

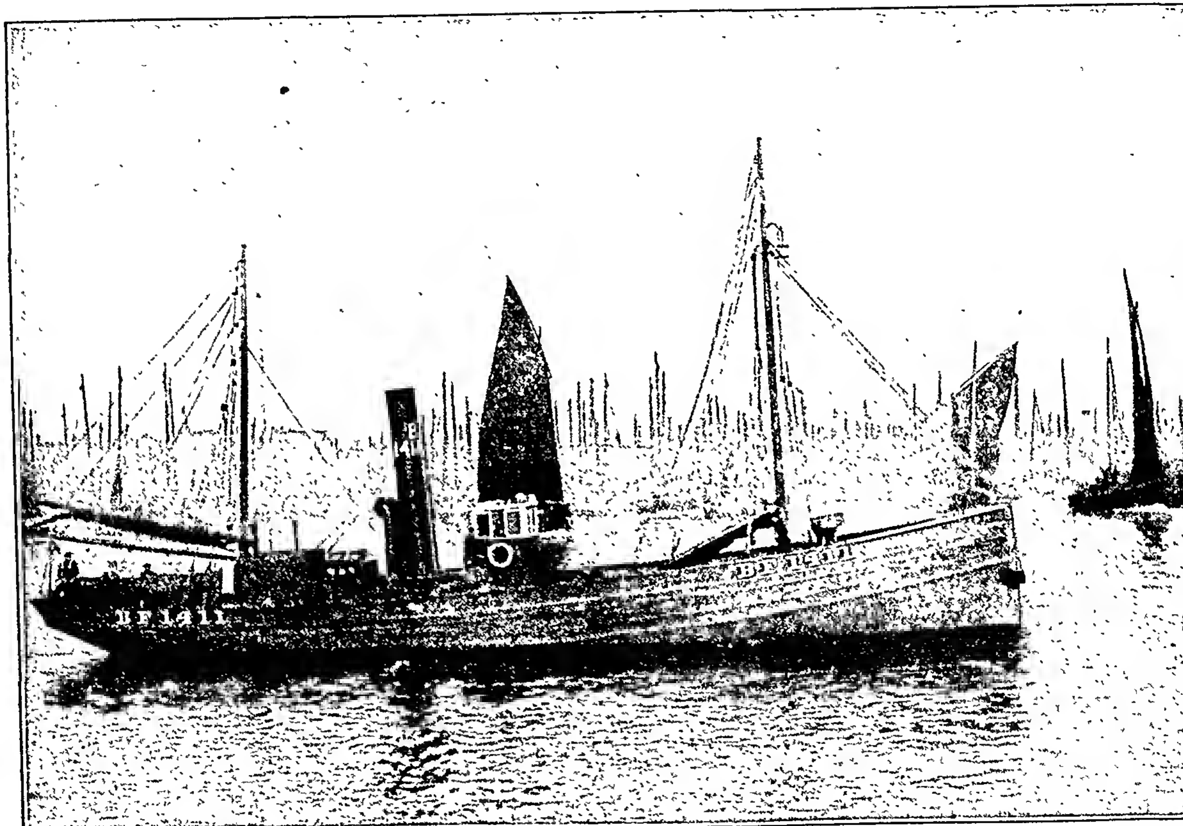
The third principal method of fishing is chiefly practised in Scotland, where a considerable quantity of demersal fish is caught by means of long lines, attached to which are baited hooks. Here, as elsewhere, this kind of fishing is falling off. A long line may be as much as 7 miles in length; at regular intervals pieces of line from 2 to 3 ft. long, the "Snoods" are attached and these snoods carry the hooks. The line is usually shot at night and fished in the morning, its position in the sea being marked by buoys. The statistics of white fish fishing in Scotland illustrate in a remarkable manner the gradual supplanting of line fishing by the steam trawler. In 1894 the catch of line fish amounted to 1,400,000 cwt., of trawl fish 1,700,000 cwt. In 1904 the totals were line fish about 754,000 cwt.; trawl fish, 1,705,000 cwt. In 1913 the total quantity of line-caught fish landed in Scotland was almost exactly the same as in 1904, but in the meanwhile the quantity of trawl-caught fish had gone up to 2,542,000 cwt.

It must not be forgotten that it is largely as a measure of protection to this and other classes of inshore fishing that the policy of closing Scottish waters to trawling has been advocated for many years by the Scottish Fishery Board. The number of resident fishermen on the shores of the Moray Firth, which may conveniently be taken as an example, fell from 12,000 in 1892 to 10,261 in 1906. Taking the districts Fraserburgh to Wick, inclusive, the totals for 1910 correspond very closely with those for 1906. For the whole of Scotland the line fishing continues to show a decline, though this is somewhat retarded, presumably because the fishermen are introducing internal-combustion engines into their boats and thus increasing their sphere of activity.

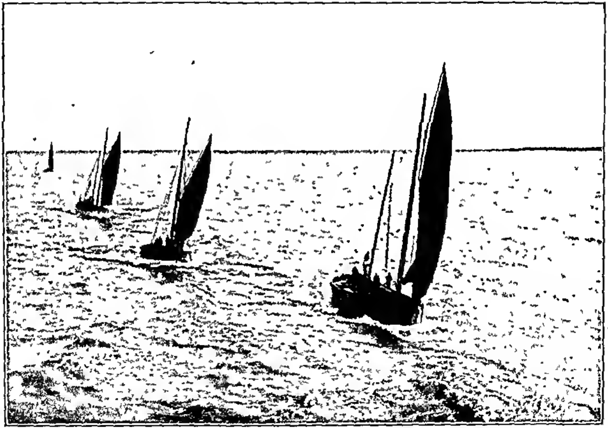
A steam drifter is usually a vessel of 90 ft. length, with a beam of 18½ ft. and a draught of about 10 ft. From the deck of the vessel rise two pole masts, from each of which a small sail can be stretched; the foremast can be lowered when the vessel is steaming against a head wind or is engaged in fishing. The vessel is divided into water-tight compartments and is usually provided with acetylene gas for lighting purposes. The engine is of the compound surface-condensing marine type, a speed of from 10 to 11 knots being developed. Such a vessel would cost in 1914 from £3500 to £4000, and its fishing equipment from £750 to £800. The sailing drifter of Scotland is being rapidly replaced by steamers of this type. Of

recent years the equipment of the sailing drifter with an auxiliary motor seems to have proved a success, and may, in all probability, delay the extinction of this class of vessel for an indefinite period

With comparatively few exceptions, where, for instance, serviceable specimens of the older type of craft termed the Scaffie are still in existence, the Fifie is the only boat employed in drift net fishing for herring by the fishermen of the towns and villages on the eastern seaboard of Scotland, from Berwick on-Tweed, from Macduff, from Wick and in the Orkney and Shetland Islands, while the Zulu is the only one used along the southern shore of the Moray Firth from Banff to Inverness Of the three types of boat the Fifie is the safest when sailing before a heavy sea, but it does not admit of such easy handling as the Zulu in waters of limited area or when entering harbour Tested by the conditions under which the boats of the Fifie model show to advantage, the Scaffie is rather a dangerous craft, owing to the extent to which its stem and stern project beyond the respective extremities of the keel On the other hand, of the three types of boat it responds most readily to the helm in confined waters such as the upper regions of the Moray Firth, at one of the creeks of which the first Scaffie is supposed to have been built, although the fact of the term "Buckie Scaffie" having been applied to this type of boat for many years would appear to throw doubt on the supposition The stem of the Zulu is similar in design to that of the Fifie, while the stern corresponds with that of the Scaffie, the great rake of the Zulu amounting to from 22 to 24 ft —as compared with 5 ft in the case of the Fifie—detracts greatly from the strength of this type of boat at the stern The first boat built on the Zulu model was launched at Lossiemouth during the progress of the Zulu war, from which circumstance it derives its name, while the lines of the Fifie are believed to have been first adopted in one of the towns or villages on the coast of Fife As on the east coast and in the two most northern counties of Scotland, the Fifie is the more popular of the two modern types of sailing drifters, a short description of a Fifie boat of the largest size is given The crew usually consists of seven men and a boy The boat is of carvel build, the upper extremities of the stem and stern project 1 and 4 ft, respectively, beyond the extremities of the keel, which is 68 ft The beam is 20½ ft, the depth of the hold above the covering boards 7½ ft The gross tonnage amounts to 56 tons The timbers are either of Scottish oak or Scottish larch, the planking above the waterline of red, white or pitch pine, below the waterline of Scottish larch, while the deck planking consists of white or red pine American elm is used for the keel and gunwale, oak for the stem and stern posts Broadly speaking, about 40 tons



A BANFF STEAM DRIFTER.



FIFIE BOATS AT SEA.

of undressed timber enter into the composition of the largest class of Fifie boat. From the point of junction with the deck the fore-mast rises to a height of from 55 to 57 ft., having at that point a diameter of 22 in., and at the top 11 in. Measured from a similar point the mizzen mast shows a height of 49 ft., its diameter at corresponding points being 15 and 7 in. A bowsprit is not now included in the equipment of a Fifie of the largest class, a jib being set only in fine weather when the boat is sailing before the wind. The sails, which are of cotton canvas, have the following areas: Mainsail, 1587 sq. ft.; mizzen, 1349; and jib, 814 sq. ft. A steam capstan forms part of the equipment, the engine being of 12 h.p. The area of drift netting carried by such a vessel amounts to 42,000 sq. yd., and consists of 70 nets, each with an area of 600 sq. yd. A spare set of netting is usually carried, occasionally two spare sets. Such a fleet of 70 nets would have a linear extension of 2590 yd. The net is tanned by immersion in a liquid composed of cutch dissolved in hot water, the success of the operation being more or less dependent on the cleanness of the nets. The bush rope, composed of the best manilla, is 2640 yd. in length and is made up of 11 coils of 240 yd. each. The boat, including mast and sails, would cost at pre-war rates from £800 to £1000, the fishing gear from £320 to £400. A Fifie boat is capable of carrying 300 crans or 1000 cwt. of herring.

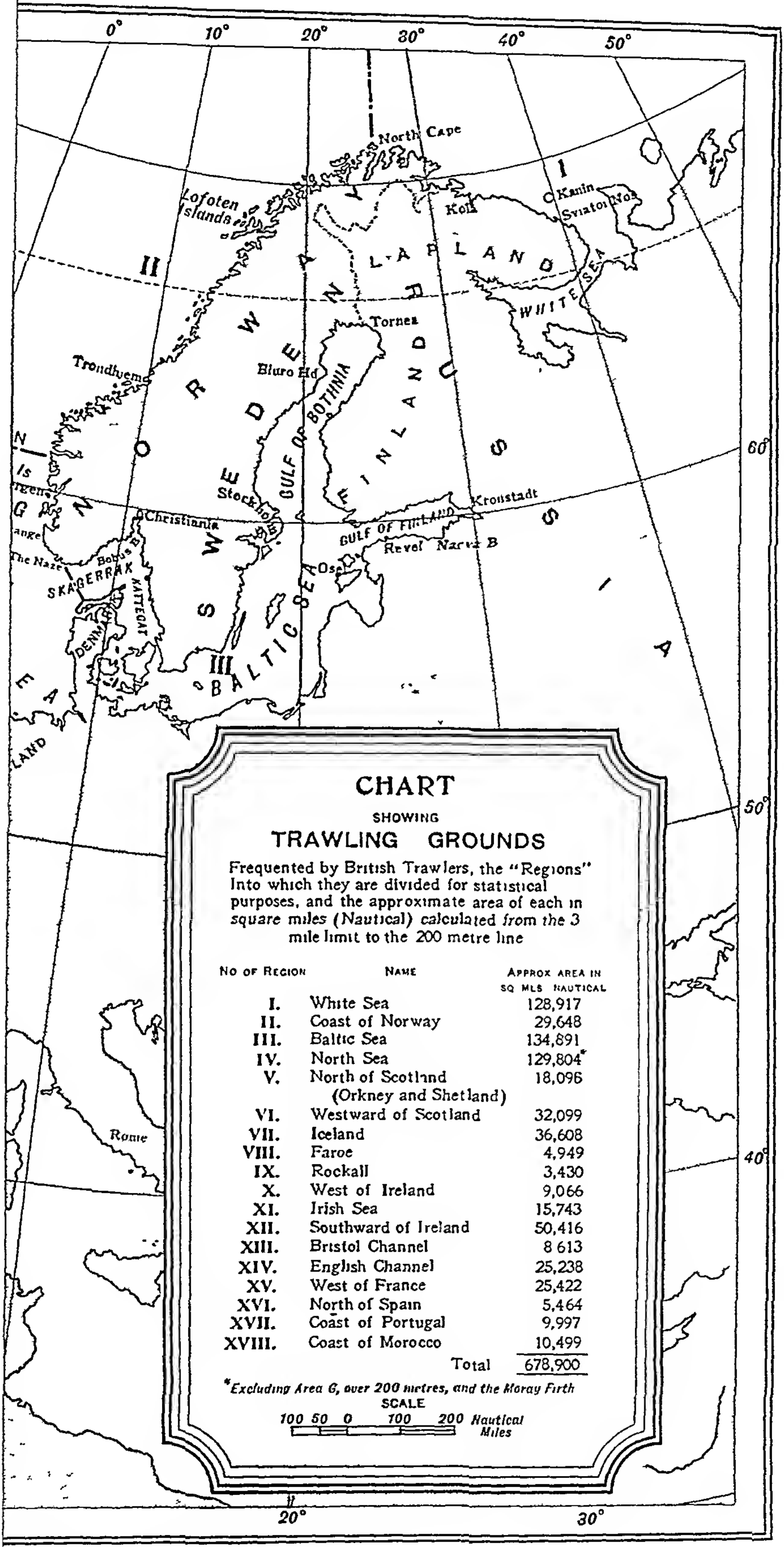
CHAPTER III

THE TRAWLING GROUNDS DRIFT NET FISHING TRAWLING FOR HERRING

IN England and Wales more fish is landed by trawlers than by all other methods of fishing combined Trawl-caught fish, consisting to a large extent of prime fish, such as soles, plaice, turbot, halibut and cod, is much more valuable than fish caught by drift nets, such as herring and mackerel, so that while the weight of trawl-caught fish is not much more than drift and draw net fish, its value is probably at least three times as great In England and Wales in 1913 the weight of pelagic fish amounted to 389 262 tons, and that of demersal fish to 418,038 tons The former was valued at £2,531,979 and the latter at £7,463 003 In Scotland trawling, though it has made remarkable progress during the last few years is still subordinate to drift net and line fishing The total value of fish landed in Scotland during 1913 was £3,997,717, representing a weight of 391,417 tons Of this 177,097 tons valued at £1,424,115 was trawl-caught fish

The area exploited by British steam trawlers is that of the continental shelf of Northern Africa and Western Europe The operations of these vessels are limited by the extent of this shelf since edible demersal fish are not met with in sufficient quantities to make commercial fishing a success at depths greater than 200 fathoms At this depth the continental shelf deepens very rapidly and 500 fathoms are soon met with For practical purposes the 100 fathom or 200 metre line may be taken as the limit of commercial steam trawling, though certain kinds of fish such as ling, hake, megrims and witches are met with in paying quantities down to 200 fathoms

For statistical purposes the demersal fish landed in England and Wales is referred since 1905 to one of fourteen fishing areas Taking these in order from North to South the first is that known as the "White Sea" This area was first visited by English trawlers in 1905, and was only then fished in the summer months Competition—ever keen—has now compelled trawlers to fish these grounds the whole year through The area is not within the White Sea proper, at any rate, not to any appreciable extent A more



No of Region	Name	Approx area in sq mls nautical
I.	White Sea	128,917
II.	Coast of Norway	29,648
III.	Baltic Sea	134,891
IV.	North Sea	129,804*
V.	North of Scotland (Orkney and Shetland)	18,096
VI.	Westward of Scotland	32,099
VII.	Iceland	36,608
VIII.	Faroe	4,949
IX.	Rockall	3,430
X.	West of Ireland	9,066
XI.	Irish Sea	15,743
XII.	Southward of Ireland	50,416
XIII.	Bristol Channel	8 613
XIV.	English Channel	25,238
XV.	West of France	25,422
XVI.	North of Spain	5,464
XVII.	Coast of Portugal	9,997
XVIII.	Coast of Morocco	10,499
	Total	678,900

G GROUNDS OF NORTH AND WEST EUROPE.

STEAM TRAWLING IN THE WHITE SEA

	Number of voyages.	Number of days' absence.	Total quantity landed. Plaice to nearest 1000	Total quantity landed. All fish cwts.	Average catch per day. All fish cwts.	Plaice landed. cwts.	Average plaice per day. cwts.	Average plaice per voyage. cwts.
1906	41	1,129	39,000	45,330	40·15	39,176	34·70	956
1907	76	2,115	81,000	91,239	43·14	81,261	38·42	1,069
1908	112	2,990	121,000	141,737	47·40	120,951	40·45	1,080
1909	231	5,106	289,000	337,406	59·88	288,962	50·39	1,251
1910	227	5,008	256,000	324,936	60·08	255,995	46·32	1,128
1911	306	7,584	256,000	373,473	49·24	255,708	33·72	836
1912	213	5,490	111,000	210,636	38·13	110,848	20·15	521
1913	108	2,730	57,000	120,455	44·12	57,196	20·95	530

proper designation would be Barents Sea. Fishing was at first most extensively carried on in the vicinity of Kanin Noss, on the eastern side of the entrance to the White Sea The White Sea grounds have proved somewhat disappointing, and the percentage of demersal fish from them landed in England and Wales has decreased from 4 27 in 1911 to 1 48 per cent in 1913 The estimated area of these grounds within the three-mile limit and the 200 metre line (109 fathoms) is 128,900 square miles From the east coast fishing ports to the Kanin Noss grounds and back means a voyage of about 3500 miles. An overwhelming percentage of the fish taken from this region is plaice. During June and July, 1913, the German Government's fishery investigation steamer the *Poseidon* made an exploratory voyage to the Barents Sea The results of her investigations show that edible demersal fish are of very limited distribution, and that only a very small part of the total area is available for steam trawling

The speedy decrease in value of the "White Sea" fishing grounds is shown by the table on the preceding page

Two other fishing regions are the Coast of Norway and the Baltic Sea British trawlers do not frequent these regions, and they are therefore not included in the English statistical tables The second region of importance is Iceland, where the estimated area of the trawling grounds amounts to 36,600 sq miles. Next to the North Sea it is the most important area in which British fishing is prosecuted, though indications of overfishing are not wanting. The fish that were thrown away when this ground was first discovered would now alone make voyages profitable The Icelandic grounds yield cod, haddock, plaice, halibut, ling and coalfish, all of which are characteristic northern types It is remarkable that even in the largest areas the general tendency is for the proportion of large plaice to be diminished after five years' steam trawling The yield of the Icelandic grounds in plaice is appended —

ENGLAND AND WALES (PLAICE ONLY)

	Total quantity landed	Average catch per day's absence
1906	186,382 cwts	5 32 cwts
1907	172,352 "	5 08 "
1908	124 532 "	3 92 "
1909	100,263 "	3 71 "
1910	90,739 "	3 08 "
1911	101,153 "	3 35 "
1912	121,264 "	3 92 "
1913	96,245 "	2 60 "

The Icelandic fishing grounds were, prior to the outbreak of the

European war in 1914, much frequented by German steam trawlers, which for the most part landed their fish at Aberdeen.[1]

In 1913 of 569 landings from Iceland grounds at Aberdeen 530 were German, 37 British and 2 Dutch, in 1914 the numbers were: German, 483; British, 42; Belgian, 14; and Dutch 1. It was a matter of common knowledge in fishery circles that the foreign fishing fleet landing at Aberdeen was almost entirely German and fished almost entirely at Iceland. In 1914, up to September, the Germans landed just over 30 per cent of the whole quantity of trawled fish in Aberdeen market. Although these foreign landings practically ceased at the end of July, they accounted for over 23 per cent of the whole Scottish trawl catch, for close on 18 per cent of the whole Scottish supply of demersal fish.

The third area of importance to British trawlers is the Faroe Bank, which is subdivided into two regions, the Faroe Islands and the Bank itself. These regions are separated by a deep water channel. The estimated area of the grounds is 4,950 sq. miles. The chief fish are cod and haddock, but halibut, coalfish and ling are also abundant. The results of the Faroe fishing as regards the total quantity landed in England and Wales and the plaice statistics are appended :—

English Landings from the Faroe Grounds

(All figures in cwts.)

	Total quantity.	Average per day.	Plaice.	Average per day.
1906	618,859	31·19	4,350	0·25
1907	667,475	34·35	3,175	0·19
1908	401,449	28·07	1,664	0·15
1909	609,393	34·94	1,558	0·10
1910	578,012	30·27	1,299	0·07
1911	600,900	31·49	1,234	0·07
1912	625,945	31·69	989	0·05
1913	658,305	28·19	1,595	0·07

It will be again noticed that the introduction of steam trawling is speedily followed by the diminution of a sedentary species like the plaice. In the table the total quantity includes the landings from both trawlers and liners, whereas the averages are for trawlers alone. Plaice is not landed by liners.

The fourth area is around Rockall, an isolated rock situated in the North Atlantic in 57°36′ North latitude and 13°42′ West longitude. There is here an extensive bank 50 miles long and about

[1] "Aberdeen Fishery Statistics, 1914–16," by D'Arcy Wentworth Thompson, *Fisheries, Scotland, Sci. Invest.*, 1917, I (October, 1917).

25 broad, which is suitable for steam trawling The area is estimated at 3400 sq miles The haddock and the ling are the two most abundant species, though northern species like the halibut and torsk are found in some quantity The plaice and coalfish are nearly absent The catch is divided fairly equally between steam trawlers and steam liners, but in some years, e g 1910 and 1912 the liners predominated

ENGLISH LANDINGS FROM THE ROCKALL GROUNDS
(All figures in cwts)

	Total quantity	Average per day Trawlers	Average per day Liners
1906	110 056	38 98	21 38
1907	122 545	41 18	23 69
1908	53 802	33 30	23 03
1909	59 736	39 51	25 06
1910	42,174	14 74	21 53
1911	30 547	29 28	17 09
1912	23 777	41 90	17 39
1913	56,496	39 27	20 31

The fourth statistical region is the North Sea, still by far the most important of the trawling areas in spite of the fact that its fishing grounds show a steady decline With a trawlable area of 152,500 sq miles it will challenge comparison merely on the point of size with any of the other regions This area is bounded on the north by latitude 61 and is separated from the Baltic by a line drawn from the Naze to Hanstholm in Denmark The Straits of Dover mark it off from the English Channel For statistical purposes it is divided into separate areas These areas comprise several thousand square miles, each distinguished according to the depth Practically every variety of demersal fish is recorded from the North Sea grounds, but, broadly speaking, the predominant species are the cod, haddock and plaice Plaice and soles are found in greater abundance in the southern shallower portion , cod and haddock in the deeper, more northerly region

The North Sea is really a shallow basin which was in comparatively recent geological times dry land The Board of Agriculture and Fisheries in their statistical tables distinguish —

Areas under 20 metres in depth as A areas
between 20 and 40 metres as B ,
„ „ 40 „ 60 , C „
, , 60 , 80 „ D „
, „ 80 „ 100 , E „
, , 100 „ 200 , F
, over 200 metres as G areas

With the exception of " E " area these are further subdivided The " A " areas have a dimension of 12,900 sq miles

Obviously the " A " areas extend in a narrow belt round the coast. Of the four subdivisions the only important one is that known as the eastern grounds. This area includes the waters off the German and Danish coasts, and touches the important small plaice grounds of the Horn Riff, Sylt, Amrum Bank and Heligoland. The bottom is of fine sand, a favourite ground for young Pleuronectids. This ground is fished for the most part in May and June, and about 90 per cent of the plaice belongs to the trade category of small. No less than 250 boxes of small plaice have been landed by a steam trawler as the result of a single trip to these grounds.

The " B " areas are much more important to the steam trawler. There are five subdivisions in the statistical tables. Of these the best known is the Dogger Bank, which has an area of 6850 sq. miles. This bank is a large wedge-shaped, submerged plateau running north-east and south-west. The apex known to the fishermen as the tail end, lies to the north-east. The base is only 60 miles from the Yorkshire coast. The tail end is separated from the rest of the bank by a gutter over 40 metres deep. The slope is gentler on its south-eastern side ; the northern slope is covered in summer by an extraordinary quantity of " scruff," of which the chief constituent is the " curly weed " or " curly cabbage," a fixed compound gelatinous organism (*Alcyonidium gelatinosum*). The bottom of the Dogger, except for a few patches of rough ground, is of fine sand. In the south-west the bank shallows to a depth of from 7 to 8 fathoms. To the fishermen the more southerly part is the inner or upper part ; the more northerly the lower or outer. Thus " inside the Dogger " is south-east of the Bank, " below the Dogger " is the north-west slope. The Dogger abounds, or at any rate at one time did abound, in haddock, cod, turbot and plaice.

Another important " B " area (20–40 metres) is that which lies between the base of the Dogger and the English coast. Here the bottom is formed of a number of alternating ridges and gutters running north-west and south-east in parallel lines. The ridges approach to within a few fathoms of the surface, and are known as the Swarte Bank, Leman Bank and Well Bank. Between these ridges the bottom is composed of fine sand. Most of the northern portion of the area is of rough ground with stones and gravel, in which are Well Bank Rough, Well Bank Flat and the Dowsing Ground. The southern portion of the area encloses parts of Haisborough Sand, Gat and Lowestoft Flats, fishing grounds much frequented by the Lowestoft trawlers. Cod, haddock and plaice are the characteristic fish of this area. The third " B " area lies off the Dutch coast. Along its southern border are a series of grounds named chiefly from the islands off which they are situated.

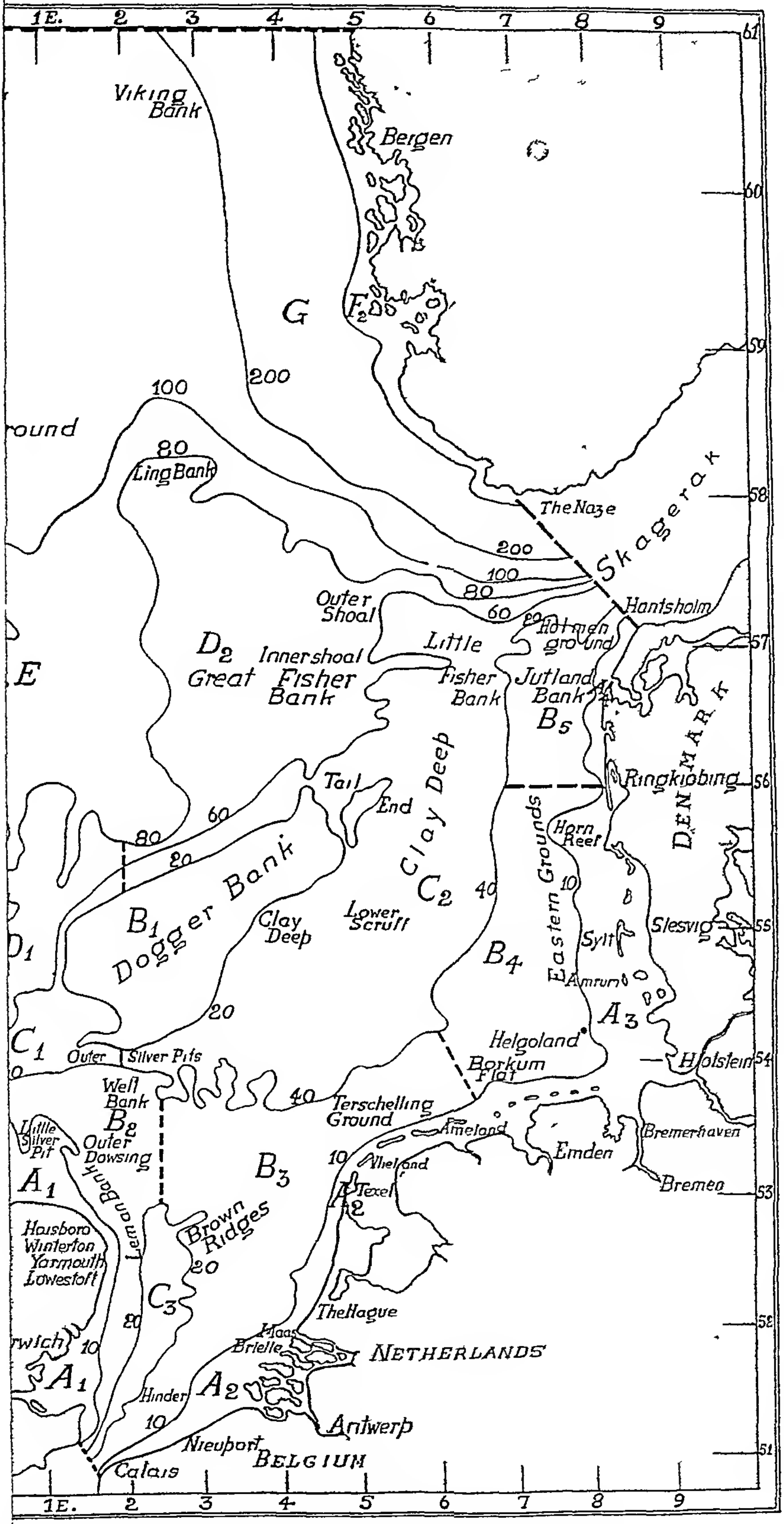
Among these are the Borkum, Ameland, Terschelling, Vlieland, Texel, Brielle, West Kapelle, Maas and Hinder grounds In the central portion lie the Brown ridges, Black bank, and the Winterton grounds, while in the north-west we have the Leman Bank In this area the bottom consists generally of fine sand and shells, except in the deeper portions to the north where mud replaces the sand Plaice is the important fish in this area Soles and turbot are also important, the remainder of the catch consisting of haddock, cod, whiting and dabs

The fourth " B " area is the seaward continuation of the eastern grounds, with which it forms the so called small plaice area The south-west portion is part of the oyster grounds, the bottom composed of sand and mud with a depth of 22 fathoms This is surrounded with rough rocky ground

The Heligoland grounds lie to the south-east, and in succession to the northward are the Amrum, Sylt and Horn Riffs The general nature of the bottom is fine sand interspersed with patches of shells and gravel The fifth " B " area is a small one lying off the North Danish coast between the little Fisher Bank and the mainland of Jutland In the centre lies the Jutland Bank and in the north the Holmen Ground In the south are the Bovbjerg and Ringkjobing grounds The bottom is mainly sand, except on the Jutland Bank, where rough ground is met with Small haddock are the chief constituent of the catches here, other fish being cod, plaice, turbots, skate, whiting and cat-fish

The " C " areas (40 to 60 metres) comprise 25 300 sq miles, and they make up the remainder of the southern North Sea The first section is made up of an irregularly shaped area lying off the east coasts of England and Scotland There are three portions joined by narrow channels The first part is the Moray Firth containing Smith Bank, the second is the area off the Firth of Forth, and the third is off Flamborough Head This last is the most important to the English fishermen It consists of a body off the Yorkshire coast, and two long arms embracing the western part of the Dogger Haddock is the predominant species, the other fish being cod plaice, whiting, skates, lemon soles, monks, ling, dabs, gurnards and cat fish

The second " C " area lies between the Dogger and the " B " areas off the Danish coast It extends in the north-east to the Skagerrack, enclosing the Little Fisher Bank South of this is a large tract known as the East (or Upper and Lower) mud This area also sends out two long arms encircling the eastern part of the Dogger In the main area lies Clay Deep The northernmost arm is known as " the Lower Edge of the Dogger " The arm running south-west includes the Great Silver Pit, a most important ground,



E NORTH SEA TRAWLING GROUNDS (DEPTHS IN METRES).

the first discovery of which gave such a remarkable impetus to trawling. It is a depression of from 30 to 35 fathoms, surrounded by steep banks. The bottom is of fine sand with patches of black mud. Intense fishing takes place throughout the whole year. Haddock, cod, plaice and whiting are the principal fish. The third "C" area is a small pear-shaped depression off the coasts of Norfolk, Suffolk, Essex and Kent. Plaice, whiting and skates are the most abundant species.

The "D" areas lie in the northern part of the North Sea, where deeper water is met with. The first "D" area, which is also the most important, lies close to the English and Scottish Coasts. Its area is 10,200 sq. miles, and the predominant species is haddock. The other fish are cod, whiting, skates, lemon soles, cat-fish and ling. Area "D 2" comprises the centre of the Northern part of the North Sea. The chief fishing grounds are the Great Fisher Bank, the Ling Bank in the north and the Outer Shoal in the east. Haddock is the chief fish, followed by cod, whiting, plaice, skates and ling.

The third area "D" lies off the Moray Firth, extending from the Orkneys to Peterhead. Haddock, cod and whiting are the principal fish.

The "E" area comprises the deeper part of the central North Sea. Its area is 16,500 sq. miles, the depths vary from 80 to 100 metres. Haddock is again the chief fish. There are no prime fish; plaice are scarce, the other important species being cod, whiting, ling and skates, with small quantities of coalfish, monks and whitches. Areas "F" and "G" comprise the still deeper portions of the North Sea up to the 61st parallel. They are not very important fishing grounds.

In 1911 the value of the sea fisheries of North-Western Europe[1] was £25,651,000, and in 1912 the value was £28,104,000. The increase from 1908 to 1912 was about 6 per cent. Great Britain claims nearly half the total, viz. £13,234,000 in 1912 or 47 per cent. France comes second with £4,794,000 or 17 per cent, then Norway with £3,096,000 or 11 per cent, Germany with £2,012,000 or 7 per cent, Holland with £1,915,000 or 6·8 per cent and Denmark with £948,000 or 3·37 per cent.

The importance of the North Sea grounds will be seen from the fact that 1,171,216 metric tons (of 1000 kilograms) were obtained thence, that is about 44·8 per cent of the total yield of the sea fisheries of North-Western Europe. The Norwegian and Polar Seas yielded 645,126 tons or 24·7 per cent, Iceland 232,160 tons (8·9 per cent), the North and West of Scotland 114,530 tons (4·4

[1] *Bulletin Statistique*, Vol. VIII (International Council) deals with 1911 and 1912. Published 1917.

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In 1911 the value of the sea fisheries of North-Western Europe[1] was £25,651,000, and in 1912 the value was £28,104,000. The increase from 1908 to 1912 was about 6 per cent. Great Britain claims nearly half the total, viz. £13,234,000 in 1912 or 47 per cent. France comes second with £4,794,000 or 17 per cent, then Norway with £3,096,000 or 11 per cent, Germany with £2,012,000 or 7 per cent, Holland with £1,915,000 or 6·8 per cent and Denmark with £948,000 or 3·37 per cent.

The importance of the North Sea grounds will be seen from the fact that 1,171,216 metric tons (of 1000 kilograms) were obtained thence, that is about 44·8 per cent of the total yield of the sea fisheries of North-Western Europe. The Norwegian and Polar Seas yielded 645,126 tons or 24·7 per cent, Iceland 232,160 tons (8·9 per cent), the North and West of Scotland 114,530 tons (4·4

[1] *Bulletin Statistique,* Vol. VIII (International Council) deals with 1911 and 1912. Published 1917.

per cent), the Skagerrack 105 102 tons (4 per cent) The yield of the Baltic was only 71,307 tons or 2 7 per cent

The total quantity of fish taken from the North Sea in recent years is given in the following table

YIELD OF THE NORTH SEA FISHERIES (IN METRIC TONS)

1907	1,123	1909	1 049	1911	1,168
1908	1 039	1910	1,115	1912	1,171

The trawl industry shows an increase from a mean of 340,397 tons in the years 1907–09 to 348 606 tons in 1910–12

The average share of the different countries in the North Sea catch in 1910–12 was (in percentages), Norway 12 7, Denmark 1 3 Germany 7 1, Holland 11 1, Belgium 0 5 England 37 1, Scotland 29 8 Great Britain thus claims 66 9 per cent of the total Comparison with former years shows that the shares of Holland and Belgium vary little, those of Norway, Germany and Denmark show a distinct increase, while Great Britain's share tends to diminish

The grounds off the North of Scotland comprise the fifth region, with an estimated area of 18,100 sq miles This includes the seas surrounding the Orkney and Shetland Islands It is separated from the North Sea by an arbitrary line drawn in a north-easterly direction from Duncansby Head to the Orkneys, and joining North Ronaldsha to Sumburgh in the Shetlands Its western boundary is the meridian of 5° west, which separates it from the sixth region The chief fish are haddock ling, skates and rays, cod and halibut are also found in some quantity

The sixth region is entitled "Westward of Scotland" in the official reports It extends from the preceding region to the southward and westward, and includes the whole of the west coast of Scotland It is separated from the Irish Sea by a line drawn from the Mull of Cantyre to Fair Head (Ireland), and from the west of Ireland by a line drawn true west from Eagle Island off the coast of County Mayo Its area is calculated at 32,100 sq miles Together with the fifth region it comprises the most northerly portion of the Atlantic continental shelf, which runs uninterruptedly as a broad plateau as far as the coast of Spain A short distance outside the 100 fathom line the shelf descends rapidly to the bed of the Atlantic Ocean Within the region there is a large available trawling area The physical features of the region are very diverse, and there is a great variety of fish Northern types, like coalfish, ling, halibut and megrims, occur along with gurnards, skates and rays, and even more southerly types, such as hake and bream

The following table gives the total quantity of fish landed from this region, and separate statistics for plaice —

West of Scotland Grounds

LANDINGS IN ENGLAND. ALL FIGURES IN CWTS.

	Total Fish.	Plaice.
1906	238,977	2,770
1907	405,823	6,673
1908	656,142	8,198
1909	782,712	12,429
1910	796,728	8,317
1911	736,807	5,097
1912	706,679	4,594
1913	609,340	757

Another region is the west of Ireland, which forms a continuation of the preceding area. It continues from Eagle Island to a line drawn west from Loop Head in County Clare. Here the continental shelf does not terminate so abruptly. The trawlable area is computed at 9000 sq. miles. These grounds, at any rate in deeper water, are well stocked with hake. The other principal fish are haddock and megrims, mixed with bream and gurnards.

The next area is that of the south of Ireland. An extensive region known as the south-west bank lies to the south and south-westward of Ireland. It is separated by an irregular line following the 100-metre sounding from the adjacent areas of the Bristol and English Channels. Considerably more than half the fish landed from this area are hake ; it may therefore be considered as a typical deep-water trawling area. The " Blaskets," an important fishing ground, lie on the line between it and the area of the west of Ireland' while another important fishing ground, the " Smalls," is on the line between it and the Bristol Channel. Its area is 50,500 sq. miles and, next to hake, skates, haddock, bream, megrims and ling are the most abundant species. The statistics of the hake landed in England and Wales from these grounds is appended :—

Hake

	West of Ireland.		South of Ireland.	
	Total weight.	Average per day. Steam trawlers.	Total weight.	Average per day. Steam trawlers.
1906	4,160	1·27	286,203	17·85
1907	2,907	16·52	679,470	17·99
1908	4,841	9·40	670,074	16·09
1909	1,487	9·46	736,528	17·04
1910	5,437	13·86	554,341	14·55
1911	30,603	12·62	510,788	15·43
1912	59,055	11·70	458,384	17·37
1913	75,248	15·31	341,929	13·24

All weights in cwts.

The Irish Sea area is much smaller than the preceding, and contains only 15 700 sq miles It is bounded by lines drawn across the St George's and North Channels This is one of the few remaining areas where a fair proportion of the fish is still landed by sailing trawlers, though the statistics prove that even here sail is being gradually superseded by steam The predominant species are cod, skates, rays and plaice, though haddock, turbot and halibut occur sparely The really important fish for the inshore fishermen are the sole and plaice In the Irish Sea the only method of steam fishing is trawling (with negligible exceptions) The deep-sea sailing fisheries are carried on by ketch rigged smacks which come under the official designation of first-class fishing vessels There are four fleets which fish this area regularly, namely the smacks of Hoylake (registered at Liverpool), Fleetwood, Douglas and Brixham The crew of these boats consists of four men or three men and a boy, though in summer they put to sea with a crew of three men only These men come into direct competition with the steamers, and in many instances are handicapped in the struggle for existence The extension of steam fishing, without any question tends to eliminate the deep-sea smack, and certain of our best types of fishermen are driven into the ranks of casual labour ashore to the manifest detriment not only of themselves, but of the community as a whole In the Irish Sea there is also a comparatively large amount of inshore trawling, principally for plaice This fishing is carried on by small second-class boats, locally known as "Nobbies", half-decked cutter-rigged craft of about 10 tons gross register with a crew of two men They carry a trawl with a beam of 25 ft, and fish in shallow water near the shore This class of fisherman does not come into competition, at least to any appreciable extent, with the other trawlers, and probably has little to fear from them, since these little boats have the shrimping or prawning to fall back on Moreover, steam trawling is illegal in the local territorial waters

The extent to which steam trawling has developed in the Irish Sea in recent years is shown by the following extracts from the official statistics

The first table relates to soles, as that is the most important fish to the smacksman In 1906 only 4 86 per cent of the soles landed in England and Wales came from the Irish Sea, and during that year the average catch of soles per day's absence from port was 0 07 cwt in the case of a steam trawler and 0 24 in the case of a smack The number of separate landings of catches of fish from the Irish Sea was for the steamers 174 and for the smacks 1511

In 1913 no less than 22 13 per cent of the total weight of soles

landed in England and Wales came from the Irish Sea, of these the steamers averaged 0·93 cwt. per day's absence from port, and the smacks 0·29. The number of separate landings was now 1951 for the steamers and 2494 for the smacks. The table gives the total catches of soles :—

IRISH SEA SOLES (WEIGHTS IN CWTS.)

	First-class boats.		Second-class boats.	Total.
	Steam	Sail.	All Sail.	
1906 . .	83	1,172	1,872	3,127
1907 . .	531	1,743	2,422	4,696
1908 . .	605	4,295	984	5,884
1909 . .	871	5,531	1,489	7,891
1910 . .	4,348	5,311	1,476	11,135
1911 . .	8,224	4,644	1,247	14,115
1912 . .	9,615	3,472	1,173	14,260
1913 . .	11,037	2,532	1,120	14,689

Returns of the sizes of the soles were first given in the statistics for the year 1909. The following shows the enormous quantities of small soles now landed from the Irish Sea.

IRISH SEA SOLES (WEIGHTS IN CWTS.)

	Steam Trawlers.					First-class Sailing Trawlers.				
	1909.	1910.	1911.	1912.	1913.	1909.	1910.	1911.	1912.	1913.
Large .	649	1,490	2,617	3,390	3,384	839	597	987	860	665
Medium .	129	1,739	2,860	3,919	4,680	2,422	2,216	1,903	1,554	1,089
Small .	42	996	2,515	2,199	2,887	1,042	995	819	506	380
Size not distinguished	51	123	232	107	86	1,228	1,503	935	552	398
Totals .	871	4,348	8,224	9,615	11,037	5,531	5,311	4,644	3,472	2,532

The official statistics show that the weight of soles landed from the Irish Sea has in eight years gone up from 83 cwt., in 1906, to 11,037 cwt., in 1913, in the case of steam trawlers. In 1909 the steamers landed 42 cwt. of small soles, in 1913 no less than 2887 cwt. Theoretically, there can be no objection to the landing of large or even of medium soles, but this practice of catching small soles is very objectionable. The Irish Sea is, as regards both soles and plaice, nothing more than a huge lake, and the question therefore arises as to how far it can stand this enormous and rapidly increasing strain ? All these small soles are immature fish. The sole matures

at a length of from 11 to 13 in In the Lancashire markets small soles are usually retailed under the name of "Southport slips' The retail price is from 6d to 8d per lb, and there would be eight fish to the pound, the length varying from 7 to 8½ in

A second important Irish Sea fishery is that for plaice The weight of plaice landed by steam trawlers has gone up from 1332 cwt in 1906 to 12,967 cwt in 1913 The weight of small plaice landed by the steamers has increased from 165 cwt in 1906 to 6887 cwt in 1913 There is no uniformity in the trade classification of plaice into "large," "medium" and "small," and different standards will be found at different ports Broadly speaking, small plaice are between 17 and 30 cm (6¾ to 12 in), medium, which are not so regular, range from 25 to 40 cm (10 to 16 in), and large from between 25 to 30 cm up to 69 cm (11 to 27 in) In the Irish Sea the plaice matures at lengths of from 11 to 15 in, so that all the small and the bulk of the medium are immature fish

IRISH SEA PLAICE STEAM TRAWLER CAUGHT

(Weights in cwts)

	1906	1907	1908	1909	1910	1911	1912	1913
Large	392	509	707	1 400	2 948	2,483	2 287	1,744
Medium	432	860	420	791	3 354	4 610	3 616	3 875
Small	165	193	287	642	4 327	5 796	5 429	6 887
Not distinguished	343	213	345	515	433	486	511	461
Totals	1 332	1 775	1 759	3 348	11 062	13 375	11 843	12 967

IRISH SEA PLAICE CAUGHT BY FIRST CLASS SAILING TRAWLERS

	1906	1907	1908	1909	1910	1911	1912	1913
Large	698	1 821	998	1 714	3 868	1 632	966	1 029
Medium	914	1 404	3 431	3 907	4 131	2 747	2 127	1 204
Small	183	90	198	71	35	264	1 028	609
Not distinguished	334	591	454	688	1 233	1 010	612	611
Totals	2 129	3 906	5 081	6 380	9 267	5 653	4 733	3 453

The next area, the Bristol Channel, is still smaller, containing only 8600 sq miles As in the Irish Sea the sailing trawler still puts up a plucky fight against extinction The Bristol Channel region is bounded seawards by the 100 metre line, and separated by a line drawn S W from the Land's End from the English Channel The chief fish are soles, skates and rays This area and the Irish Sea are similar in many respects The following table illustrates

the change which is taking place in the methods of fishing in the Bristol Channel.

BRISTOL CHANNEL. DEMERSAL FISH
PERCENTAGE TAKEN BY VARIOUS FISHING VESSELS

	First-class vessels.			Second and third-class.
	Steam trawlers.	Sail trawlers.	Steam liners.	All sailing trawlers.
1906 . .	20·79	51·99	13·29	13·83
1907 . .	41·21	33·40	23·30	2·19
1908 . .	27·77	50·33	19·08	2·82
1909 . .	27·25	52·44	17·14	3·17
1910 . .	27·00	56·08	14·50	2·42
1911 . .	*51·67*	*38·97*	*7·27*	*2·19*
1912 . .	46·79	39·99	9·70	3·52
1913 . .	47·28	35·42	7·76	9·54

The English Channel has a potential trawling area of 25,200 sq. miles. Its western boundary is the 100 metre line. A large proportion of the fishing takes place in the shallow inshore waters, and the area is for the most part exploited by small fishing vessels of the second and third class. Soles, brill and turbot form the most important part of their catch. In 1906 steam trawlers only landed 4·58 of the demersal fish taken from this region, and the first-class sailing trawlers were responsible for 43·59 per cent. In 1913 the position was not materially changed, the steamers landing 6·69 and the smacks 44·51 per cent. In 1906 the second and third-class boats landed 46·87 per cent and in 1913, 41·20 per cent of the demersal fish.

The Biscayan grounds include a trawlable area of over 31,000 sq. miles along the shores of the Bay of Biscay, from Ushant to Cape Finisterre. Along the North of Spain the strip is very narrow, comprising only 5464 sq. miles, the water rapidly deepening to 1000 fathoms. The chief fish is hake and it is probable, that apart from this species, trawling on these grounds would prove to be unremunerative. In 1906 the steam trawlers landed 61,952 cwt. from this area, of which 75 per cent were hake, in 1913 they landed 14,505 cwt., of which nearly 60 per cent were hake.

Finally we come to the Portugal and Morocco regions, comprising together 20,500 sq. miles. They consist of a very narrow band of trawl grounds from Cape Finisterre in the north to about latitude 30° N. in the south. There are about 10,000 sq. miles off the coast of Portugal and 10,500 off the coast of Morocco. Hake, soles, and

skates predominate Bream is the only other fish taken in any quantity

Below 30 N latitude off the west coast of Africa there are trawling grounds within the sphere of action of British steam trawlers These grounds are situated off the coast of French West African possessions (Senegal) and a certain amount of exploratory trawling has already been done between Cape Blanco and Cape Vert under the auspices of the French Colonial Government [1] A detailed consideration of these grounds is beyond the scope of the present volume It should be noted, however, that the bottom is favourable for trawling to the north west, west and south west of Cape Blanco, on the seaward edge of the Bank of Argum, south of Nouakchott and near Guet N'Dar

On some of these grounds the common sole is abundant, while on others it is replaced by more southern forms belonging to the genera Synaptura and Cynoglossus Species of Dentex Serranus and Sciæna are abundant, these fish would probably be termed by British trawlers " Rock Cod " Fish allied to the ray and skate of British waters are not uncommon Lobsters and prawns are also numerous on these grounds

QUANTITY OF DEMERSAL FISH LANDED FOR EACH REGION

(Expressed as percentages)

	1906	1907	1908	1909	1910	1911	1912	1913
White Sea	0 57	1 02	1 64	3 84	3 80	4 27	2 46	1 48
Iceland	20 90	18 77	20 04	15 51	17 27	18 74	18 73	22 89
Faroe	7 79	7 50	4 64	6 93	6 76	6 86	7 32	8 07
Rockall	1 38	1 38	0 62	0 68	0 49	0 35	0 28	0 69
North of Scotland	0 12	0 17	0 41	0 66	1 09	1 04	0 80	0 94
North Sea	54 75	49 58	47 20	45 14	43 63	42 42	43 74	41 49
English Channel	2 78	2 23	2 12	2 10	2 02	2 11	2 54	2 37
Irish Sea	0 95	1 33	1 34	1 49	1 98	2 58	2 62	2 77
Bristol Channel	1 02	1 13	1 25	1 23	1 28	1 61	1 61	1 39
Westward of Scotland	3 01	4 56	7 59	8 90	9 31	8 41	8 26	7 59
West of Ireland	0 09	0 05	0 25	0 06	0 16	0 87	1 89	1 82
Southward of Ireland	5 55	11 66	12 09	12 79	10 97	9 87	9 01	7 64
Biscay	0 78	0 48	0 51	0 12	0 33	0 22	0 37	0 18
Portugal & Morocco	0 31	0 14	0 30	0 55	0 91	0 65	0 37	0 68

Drift netting for herrings is carried on off the coasts of Scotland and Ireland and the east coast of England In Scotland three seasons are distinguished —

I The winter herring fishery, which includes the first three

[1] Reference should be made to *L Industrie des Pêches aux Colonies* par G Darboux Marseille 1906 Vol II p 170 and *Les Pêcheries de l Afrique occidentale Française* par A Gruvel Paris 1906

months of the year, and is carried on mainly in the Firth of Forth; at Wick and Stornoway.

II. The early herring fishery was formerly carried on mainly in May and June, almost exclusively on the west coast, and to the west of the Shetlands; but is now mainly an east coast and east side of Shetland fishery.

III. The great summer herring fishery, from 1st July to the end of the year, carried on at the Orkneys and Shetlands, at Aberdeen, Peterhead, Fraserburgh and Wick. The total yield of the Scottish herring fisheries since 1909 is appended:—

	Quantity (cwts.)	Value (£s).	Average price per cwt.
1910 . . .	5,687,226	1,594,308	5/7
1911 . . .	5,036,484	1,505,334	6/-
1912 . . .	5,201,300	1,910,533	7/4½
1913 . . .	4,449,323	2,087,754	9/4½

The English drift net herring fishery is practically confined to the east coast, and follows the Scottish great summer herring fishery. There are other local herring fisheries in England and Wales, notably that carried on in Manx waters, but they do not contribute an appreciable proportion of the total catch. The east coast fishery commences in May at North Shields and increases in June, July and August, when Grimsby, Hull, Scarborough and Hartlepool commence operations. At the first three of these ports the maximum catch is obtained in September. In this month the landings at Yarmouth and Lowestoft begin reaching their maximum in October, decreasing again in November. In November the landings at the majority of southern and south-western ports are the greatest, but the quantities are, in the aggregate, small. Scottish fishermen and fishing boats take considerable part in the great English fishery, Scottish lasses being extensively employed in the preparation of the herring for the continental markets. In 1913 the herring fishery was universally successful; no less than 1163 Scottish fishing boats proceeded to the English fishing, the fleet being made up of 854 steamers, 100 motor boats and 209 sailing drifters. Except in the case of sailing boats this is a marked increase on previous years' figures. Year by year the tendency is for the sailing boat to drop out of this fishing, the reason being that the crowded state of the East Anglian ports renders some form of mechanical power almost essential. These Scottish boats caught 2,488,183 cwt. of herring at the English fishing, the total yield for the whole of England and Wales being 7,313,425 cwt. The value of the Scottish-

caught herring is given at £763 256 for 1913 The average earnings per vessel were for steamers £794 motor boats £365 and sailing boats £235

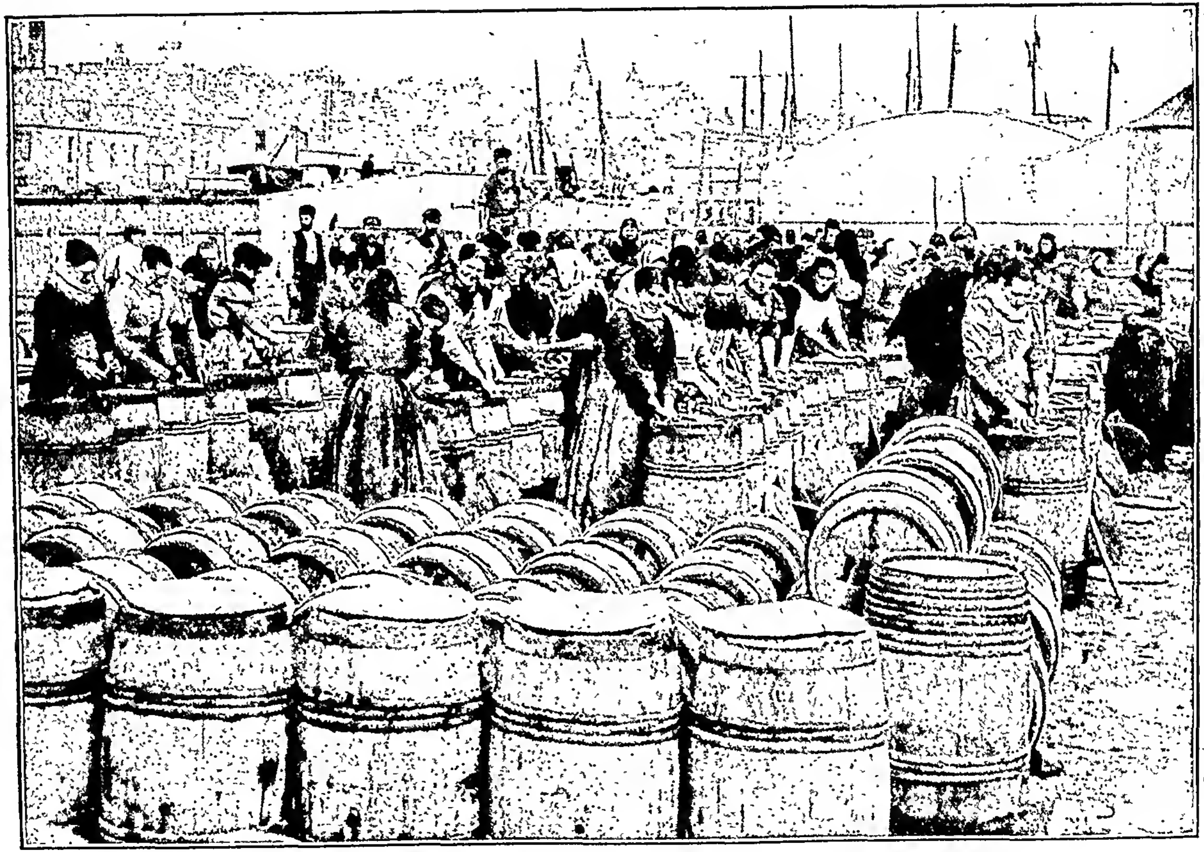
The total yield of herring for 1913 was —

	Cwts	£
England and Wales	7 313 425	2 325 084
Scotland	4 449 323	2 087 754
Ireland	420 620	159 457
Grand total	12 183 368	4 572 295

In Scotland in 1913 the total quantity of herring landed was nearly 4½ million cwt Of these 95 per cent were preserved in one way or another The quantity of herring pickled kippered or tinned was equivalent to 1 616 426 barrels, while the equivalent of 25 614 barrels was sprinkled with salt or iced

In England and Wales the bulk of the sea fish landed (except herring) is consumed in a fresh condition but in Scotland a large proportion, particularly of herring is cured in some form or other The only two ports in England in which herring curing goes on on a large scale are Yarmouth and Lowestoft In Scotland the Fishery Board brand the herring barrels the brand indicating the nature of the contents, being in effect a State guarantee of the product which was before the war for the most part exported to Germany and Russia A Herring Fishery (Branding) Act was passed in 1913 to provide for the branding of barrels of herring in England and Wales In Scotland herring branding has been in force in some form or other since 1718[1] From 1808 to 1815 2s per barrel of cured herring was paid as a bounty, provided the herring were cured and packed in accordance with the regulations prescribed by the Board In addition the sum of 2s 8d was paid on each barrel of herring exported From 1815 to 1826 the bounty amounted to 4s per barrel of cured herring The bounty was then gradually reduced ceasing entirely in 1830 These bounties were intended as a means of developing the herring fisheries and of improving the methods of curing To prevent frauds in the payment of the bounty the barrels were branded In 1809 when the above mentioned payments were first made (under the terms of the Act of 1808), the total number of barrels of cured herring was only 90 000 in 1830 when the payments were discontinued the number had risen, with minor fluctuations, to 444 000 barrels For a few years afterwards the catch and cure of herrings fell off slightly, but in 1834

[1] The present system of herring branding practically dates from the Act of 1808 But for fuller particulars see Chapter V (*infra*)



PACKING HERRING FOR EXPORT.

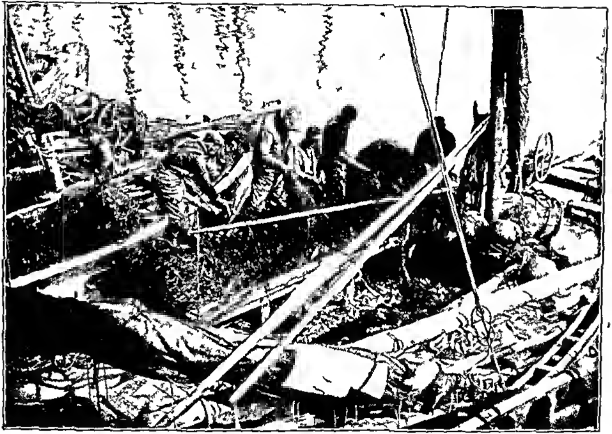
SHAKING THE HERRING FROM THE NETS

an increase was noticed. At the time of the discontinuation of the bounty system the brand had achieved such a reputation that it was retained even when unaccompanied by the bounty. Proposals to discontinue the Government brand have been made from time to time, notably in a Treasury minute dated 18th December, 1855, and in the *Report of the Sea Fisheries Commission of* 1863 (p. 174).

The retention of the brand is not surprising, since the object aimed at by the Government inspection of barrels is the maintenance of a high standard of cure, although, since every individual barrel is not examined, it must be obvious that success in attaining this object depends on the amount of co-operation on the part of the curers. The best interests of the curers are secured by exercising care that no barrels are used in the curing of herrings unless they are composed of first-class wood; that only such herrings as are suitable are used for the purpose of cure; that at the different stages of the process the work of the gutters and packers is closely supervised, and that between the dates of curing and shipment the herring receive sufficient protection from the sun and weather. The distances to be travelled by Scottish-cured herring before they reach the consumer point out the necessity of adopting the first recommendation. With regard to the second recommendation attention should be drawn to the employment in the fish-curing trade of " overday's " herring, that is fish which have not been gutted, cured and packed within twenty-four hours of the time of capture. Herring of this description can never form the basis of a satisfactory cure, and their presentation for official inspection, with a view to branding is a distinct breach of the Board's regulations. The third recommendation is necessary because the original excellence of the herring cannot compensate for carelessness exercised in the cure. Exposure to unfavourable climatic conditions, particularly to the heat of the sun, should be avoided, since the responsibility of the curer for the condition of the fish does not cease with the stamping of the barrel with the imprimatur of the Board.

The Crown brands at present in use in Scotland[1] are: Mattie (i.e. maidens) are young herring not less than 9 in. in extreme length. In these fish the reproductive organs are not fully developed. The brand " Mat. full " is applied to herring with roe or milt clearly seen at the throat, not less than $9\frac{1}{4}$ in. in extreme length. " La. full," i.e. large full, are herring with roe and milt, and not less than

[1] For impressions of the official Crown brands see *Eighteenth Annual Report of the Fishery Board for Scotland,* being for the year 1899. Part I General Report, Appendix N., Glasgow, 1900.



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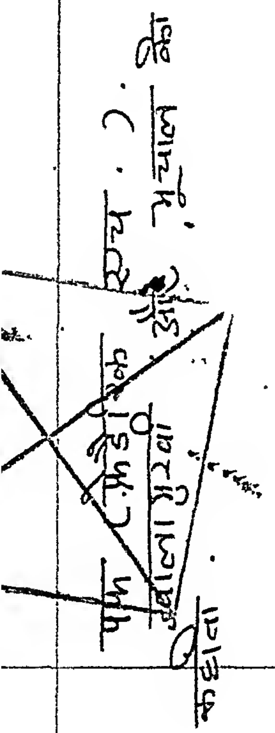

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nds see *Eighteenth Annual Report of* year 1899. Part I General Report, Appendix N., Glasgow, 1900.

furnished with a small meshed otter-trawl began in the earlier years of the present century, and its inception was due to the enterprise of the fishermen of Milford Haven and Fleetwood. At the commencement of this method of fishing the net used was the ordinary otter-trawl, either partly laced up or lined with a piece of herring net. Subsequently a specially manufactured net was introduced, which is now used by nearly all vessels engaged in this class of fishing. It is unnecessary to go into technical details as to the construction of this net; it is sufficient to say that it differs from the ordinary otter-trawl in that the last 60 ft. of the net, i.e. the catching part, is of extra small mesh, the cod-end or tail-end being of 2¼ in. mesh instead of the customary 3½ in. In 1911 trawling for herring developed so rapidly that its extension alarmed the herring drifters, who started an agitation against it,[1] an agitation which resulted in the appointment of a Committee of inquiry by the Prime Minister. Trawling for herring is usually carried on in daylight, and the best hauls are made at midday.[2] At night this method of fishing is less successful, as the herring generally rise to the surface in the dark when they are caught by the drifters. When trawling the steamers go at full speed, a marked contrast to ordinary trawling, and the fastest steamers are the most successful. The haul generally lasts from 2 to 4 hours, except when a shoal is encountered, half an hour is then sufficient. The first fishing grounds worked by this method were those stretching from Barra Head southwards to the Island of Inistrahull, on the N.W. coast of Ireland. The greater part of the fleet engaged was composed of trawlers from Milford Haven and Fleetwood; prior to 1908 few Scottish trawlers took part in this fishing. In that year several Scottish vessels, stimulated by the success of the Fleetwood fishermen, tried the new method of fishing with considerable success. In 1909 at the port of Aberdeen a fleet of twenty-one trawlers was fitted out to trawl for herring, but the fishing proved a complete failure. The same thing happened in 1910. The failure of the fishing in 1909 and 1910 was ascribed, by those engaged in it, to the pollution of the fishing grounds by dead saithe or coalfish (*Gadus virens*), which, taken in considerable quantities with the herring, were thrown overboard from the English vessels, the livers only being retained. Since then a demand has been created for saithe at Milford Haven and Fleetwood, the fish being now salted and cured for foreign markets. The quantity

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11½ in in extreme length The official stencil mark is affixed to the head end of every barrel which receives the burnt-in official brand on the bilge Letters appear on the brand which are the initials of the Board's branding officer, the numerals showing the year of packing These pickled herring are more numerous than all the other varieties of cured herring taken together In the preparation of the fish considerable skill is required, after the gills and intestines are removed the fish are brine salted and then packed in barrels and half barrels In Scotland the curing industry is an important source of income to a large number of people Men and women to the number of nearly 38,000 were engaged in 1913 as coopers, gutters, packers, and as seamen in carrying vessels Of this number 12,872 consisted of women employed solely in gutting herrings, and their total earnings for the year amounted to about £318,000, or an average per woman of £25 (including arles, wages, lodgings (in England) and train fares) The number of barrels of herrings cured, gutted and ungutted, shows a steady increase from 89,934 barrels in 1811 to 1,886,596 in 1913 Of the total cure of pickled herrings 87 per cent is exported The export to Germany was 672,701 barrels in 1913 and to Russia 619 680 barrels There was an import duty of 3s per barrel in Germany and 13s per barrel in Russia

The other varieties of cured herring[1] are the bloater, kipper and red The bloater is intended for immediate or early consumption, and is a round or unsplit herring which has only been slightly salted and smoked The fish, as soon as possible after capture, are dry salted for from 6 to 24 hours, the longer time being for the fatter fish, and then smoked

The red herring is generally prepared for foreign consumption The fish are salted in brine for two days and then smoked for a fortnight The wood and sawdust used for smoking is of the "hard" variety, and from this the peculiar flavour of the red is derived The red may be defined as a round herring, heavily salted, and smoked for a long time They are usually packed in barrels or half-barrels, the former containing 500 to 600 fish

Kippers are first of all split and gutted, then salted in strong brine for a short time, usually less than an hour, then spread out and smoked over wood shavings

A new factor has been introduced into fishery reckoning during the last few years through the capture of large quantities of herring by steam trawlers Hitherto these fish had been looked on as a monopoly of the drifter Trawling for herrings by steam trawlers

[1] For a detailed description of methods of fish curing see The Art of Fish curing published by the *Fish Trades Gazette* London

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of trawl-caught herring landed in England and Wales during the period 1907–1913 is shown in the appended table —

ENGLAND AND WALES
HERRING LANDED BY STEAM TRAWLERS

	Cwts	Per cent total catch of herring
1907 . . .	134,390 ..	3
1908 . . .	163 880	4 1
1909 . . .	106,834 ..	2 3
1910 . . .	55,475 .	1 5
1911 . . .	292,575 .	5 9
1912 . .	283 330 ..	5 3
1913 . . .	528,356 .	7 2

The herring taken on the western grounds were captured in from 70 to 100 fathoms of water, with a soft bottom They were of very large size, running from 600 to 650 fish to the cran, and they sold, on the average, for about 30s per cran, or ½d per fish They were chiefly used for "redding" and kippering, the reds being packed in small barrels and dispatched, via Liverpool, to the Mediterranean markets, while the kippers were placed on the home markets These herring appear to spend the autumn and winter months within an area whose outer limit is a line drawn from Barra Head to Downings Bay and are a typical Atlantic herring With the failure of the western grounds in 1910, interest in this class of fishing abated, but in September of that year an Aberdeen trawler landed a shot of 60 crans taken in the North Sea, 120 miles N E of Aberdeen This revived interest in herring trawling, more especially as the North Sea was a virgin field for this class of fishing The results were not uniformly successful, but a few vessels did very well

The fish taken in the North Sea were much inferior to those from the western grounds Consisting at first of full matties, and subsequently of spents, they were graded in three selections (1) 980 to 1200 fish to the cran, (2) 1759 to 2100, (3) 2450 to 2890; a considerable reduction in size to the western fish

As the fishing progressed the herrings caught became smaller, and large quantities of immature herrings of from 4 to 7 in in length were thrown back into the sea dead As in the case of the western fish, the bulk of the North Sea fish were converted into kippers and reds

The main centre for trawl-caught herring is now the North Sea, the quantity taken from that area and landed in England and Wales having increased from 7430 cwt. in 1907 to 421,347 cwt in 1913 The next most important grounds are the south of Ireland and the Bristol Channel, which together show an increase from

29,875 cwt. in 1907 to 103,197 in 1913. The west of Scotland grounds show a decrease from 87,382 cwt. in 1907 to 2650 cwt. in 1913.

A somewhat detailed consideration of the drifters' complaints is necessary for a proper appreciation of their attitude. The ancient method of catching herring in most North European waters was by means of a drift net. It was in 1902 that the first catch of trawled herring was landed at Wick, by the steam trawler *Strathnaver* of the Aberdeen Trawling Company. The skipper of this vessel was stoned by the local fishermen. With the growth of trawling for herring, described above, the agitation against it on the part of the drifters increased, until it culminated in a meeting, at Yarmouth in October, 1912, of representatives of all concerned in the prosperity of the herring drifting trade. It may be remarked, *en passant*, that the open sea is free to all methods of fishing, and the antiquity of any given method does not confer any privileges on those who practise it. Both drifters and trawlers have a common law right of fishing in an unrestricted manner, in the open sea, and such common law right is only limited by special regulations, such as those for the preservation of the peace amongst various classes of fishermen, as in the Sea Fisheries Regulation Act of 1883.

What, then, are the objections urged by the drifters against the capture of herring by steam trawlers ? In the first place the drifters state that steam trawling is, as compared with drifting, a wasteful and destructive method of fishing. It is pointed out that in spite of the enormous increase of steam trawling on the east coast of England during the last decade, there has been an actual diminution in the quantity of trawl-caught fish landed at east coast ports during that period.[1]

In 1903 the quantity of trawl-caught fish landed from the North Sea by first-class trawlers at the east coast ports, except London, was 3,801,461 cwt., the average catch per day being 18·64 cwt. From then till 1913 there is a steady and continuous decline. In the latter year only 2,073,313 cwt. were so landed, the average catch per day diminishing to 14·08 cwt.[2] Contrast this with the results obtained by the drifters. In 1903 herring drifters landed 2,913,671 cwt. of that fish at east coast ports. Since then there has been a progressive increase, until in 1913 the total was 6,935,413 cwt. In the case of the trawlers there is a decline of 39·6 per cent ; in the same period the drifters increased their catches by 61·7 per cent. It is urged by the drifters that the trawl destroys the herring eggs, which, as is well known, are deposited at the bottom of the sea. The shoals are also said to be disturbed during the spawning

[1] See Appendix V, p. 278. [2] Appendix V, p. 278.

process, and in addition to the eggs, large numbers of young and immature herring are destroyed Specific instances of destruction have been frequently quoted by the drifters, e g of a trawler landing 26 boxes of small herring and 14 boxes of large, and during the same voyage throwing over the side 50 boxes of herring too small to be marketable It is freely stated by the drifters that their own nets being of uniform mesh, which in the case of the steam drifter are thirty to thirty one meshes to the yard of very fine cotton (36/9 ply), and only designed to catch an adult herring do not cause destruction of this kind, and to this fact is attributed the success which has hitherto attended this method of fishing The drifters' nets fish the intermediate layers of water, and consequently do not disturb the herring shoals when they are on the bottom, and in the act of spawning Drift net fishing has gone on for centuries, and it is claimed that Yarmouth has records of this method dated 900 years ago Another accusation made by the drifter is that trawl caught herring is of inferior quality, and incapable of being salted properly It is alleged that in August, 1913 at Grimsby huge catches of trawled herring were sold at 5s per cran, whereas herring landed by steam drifters the same day at the same place realised 42s per cran One thing is certain, trawled herring lose their scales in the rough handling they get, and therefore are not of such attractive appearance as those caught by the drifters Whether they also undergo deterioration in flavour is necessarily largely a matter of opinion

In 1913, probably as a result of the agitation initiated by the Yarmouth Conference, when a "National Herring Fisheries Protection Association" was founded, the Prime Minister appointed a Committee to inquire into the whole question

An international conference of representatives of the herring drifting interests was held in London in 1914 (January), at which delegates from English, Scottish, Dutch, German, French and Russian herring fishing societies attended A large number of complaints were heard, similar to those put forward at Yarmouth the previous year It was decided to arrange for international action for the protection of the herring fisheries, but any slight measure of success likely to result from the efforts of the drifters was naturally ended at the outbreak of war [1]

[1] For fuller information see A Cligny Le Chalutage du Hareng *Annales de la Station Agricole de Boulogne sur Mer* Nouvelle Série Vol III 1914 p 29

CHAPTER IV

CONSIDERATION OF INDIVIDUAL FISH (THE PLAICE, SOLE, HADDOCK AND HERRING)

THE PLAICE (as a type of flat-fish)

THE two most important families of demersal fish in Northern European waters are the Pleuronectidæ (plaice family), and the Gadidæ (cod family), of which latter the haddock is a member. Without these two families steam trawling would speedily collapse. The former family, the plaice, comprises species which are for the most part sedentary, and may therefore be susceptible of permanent and serious diminution as the result of overfishing. The haddock is believed to be less sedentary than the plaice. As a means of solving problems connected with the questions of overfishing, the study of species like the plaice and haddock is of importance. With the exception of the herring, the plaice has been the subject of more controversy than any other species of marine fish. Within the last few years considerable attention has been devoted to the study of this fish and the results of the various investigations are not without interest, though the task of wading through the mile-long columns of statistics is Sisyphean.

The plaice (*Pleuronectes platessa*, L.) is probably the best known member of the flat-fish family. This family is characterised by three easily recognised peculiarities; both eyes are on one side of the body, the eyed surface is coloured, the other side being white; the dorsal fin extends forwards as far as, or even beyond, the eyes, running along the edge of the head, not between the eyes.

Seven genera and fourteen species of Pleuronectids are known to inhabit British seas. Of non-British genera and species, several are now accessible to British markets, being captured by steam trawlers in Portuguese and Moroccan waters, for example, "soles" of the genera Synaptura and Cynoglossus.

Of the genus Pleuronectes there are five British species, namely *Pleuronectes platessa* (the plaice), *P. limanda* (the dab), *P. flesus* (the flounder), *P. cynoglossus* (the witch) and *P. microcephalus* (the

lemon sole) The following tables give the total quantity and value of these five species landed in the British Isles in 1913 —

WEIGHT IN CWTS (1913)

	England and Wales	Scotland	Ireland	Total
Plaice	699 298	46 160	12 018	757 476
Lemon Soles	59 522	36 696	—	96 218
Dabs	107 343	9 907	—	117 250
Witches	36 266	30 269	—	66 535
Flounders	6 015	8 239	—	14 254
Value in £s (1913)				
Plaice	1 011 374	71 601	12 419	1 095 394
Lemon Soles	162 440	83 472	—	245 912
Dabs	100 434	4 039	—	104 473
Witches	47 425	29 289	—	76 714
Flounders	4 814	5 525	—	10 339

It is seen that both as regards quantity and value the plaice is the most important member of the genus Pleuronectes

The plaice may be recognised by the following characters [1] Eyes on the right side mouth at the end of the snout, teeth most developed on the blind side scales small and embedded in the skin bony knobs on the head between the eyes and red spots on the upper side of the body The plaice grows up to a length of about 33 in , the sizes usually met with in commercial fishing are referred to below According to Holt the female plaice spawns in the North Sea at an average length of 17 in in the English Channel Cunningham found nearly all plaice were mature at 15 in

On the other hand in Danish waters spawning female plaice have been taken at a length of only 7 in As a rule the male attains sexual maturity at a lesser size than the female and in the North Sea ripe male plaice have been captured which were 9 in in length In the northern part of the North Sea the average size at which the plaice first becomes mature is for the female 15½ in and for the male 12½ in According to Petersen[2] the average size in Danish waters is much less than this Plaice first become mature in the Baltic at an average size of 10 in in the Lesser Belt at 11 in and in the Kattegat at from 12 to 13 in

Probably the plaice spawns annually after sexual maturity is

[1] For a detailed account of the structure of the plaice see *Lancashire Sea Fisheries Laboratory Report* for 1901 Appendix Memoir on the Plaice by F J Cole and J Johnstone

[2] *Fourth Report Danish Biol Station* 1894 p 3

attained, but there is no positive evidence of it. The spawning period of the plaice has been very well determined for various parts of the North Sea.[1] On the east coast of Scotland it extends from the end of December in some years, but more usually from the early part or middle of January, to the early part or middle of May, the chief spawning taking place in March. The commencement and duration of the spawning season vary in Northern European waters. In the Danish seas it begins in November, attains a maximum in January and February, and ends in April.

According to Buchanan-Wollaston[2] there are three separate spawning areas for plaice in the southern North Sea; off Flamborough, east of the "Dogger" and the Flemish Bight. Of these the last is much the most important, being supplied with fish from distant portions of the North Sea, as proved by the marking experiments. The centre of the Flemish Bight area lies to the eastward of the Gabbard and Galloper Lightships. The area seems a well-defined one, the greatest number of pelagic eggs being found near the centres of highest salinity and temperature.

In Loch Fyne in the Firth of Clyde no plaice eggs were found in 1898 until the middle of February, and there were none left after June. In the Irish Sea the writer has taken the eggs of the plaice in mid December in Cardigan Bay, but the main spawning season is in March. From a quarter to a half a million eggs are produced by a female plaice, this being a considerably smaller number than that of some of its near relatives. The turbot produces on an average over 8½ millions, the flounder about a million, and the sole about 570,000 eggs. The eggs are naturally not extruded at once, the process of spawning being a gradual one. This is a physical necessity, since the female cannot hold all the eggs at the size they attain when mature, and they must ripen gradually and in succession.

It is evident that during the spawning season an immense number of fish eggs must be present in the seas round the spawning grounds, and efforts have been made to determine the numbers approximately. Reference is made below to the estimates made by Hensen[3] in the Baltic to determine the number of cod and plaice eggs in a certain area (p. 234). In a similar manner, Williamson[4] determined the number of plaice eggs in Loch Fyne in the spawning season of 1898 to be 483 millions.

[1] Wemyss Fulton, "On the Spawning and Fecundity of the Plaice," *24th Ann. Rept. Scots. Fish. Bd.*, Part III, 1906.

[2] H. J. Buchanan-Wollaston, *Report on the Spawning-grounds of the Plaice in the North Sea*. Board of Agriculture and Fisheries. Fishery Investigations. Series II. Sea Fisheries, Vol. II, No. 4. London, 1915.

[3] Hensen und Apstein, *Wiss. Meeresuntersuch.* Kiel Commission. Bd. 2, N.F. Heft 2, p. 71, 1897.

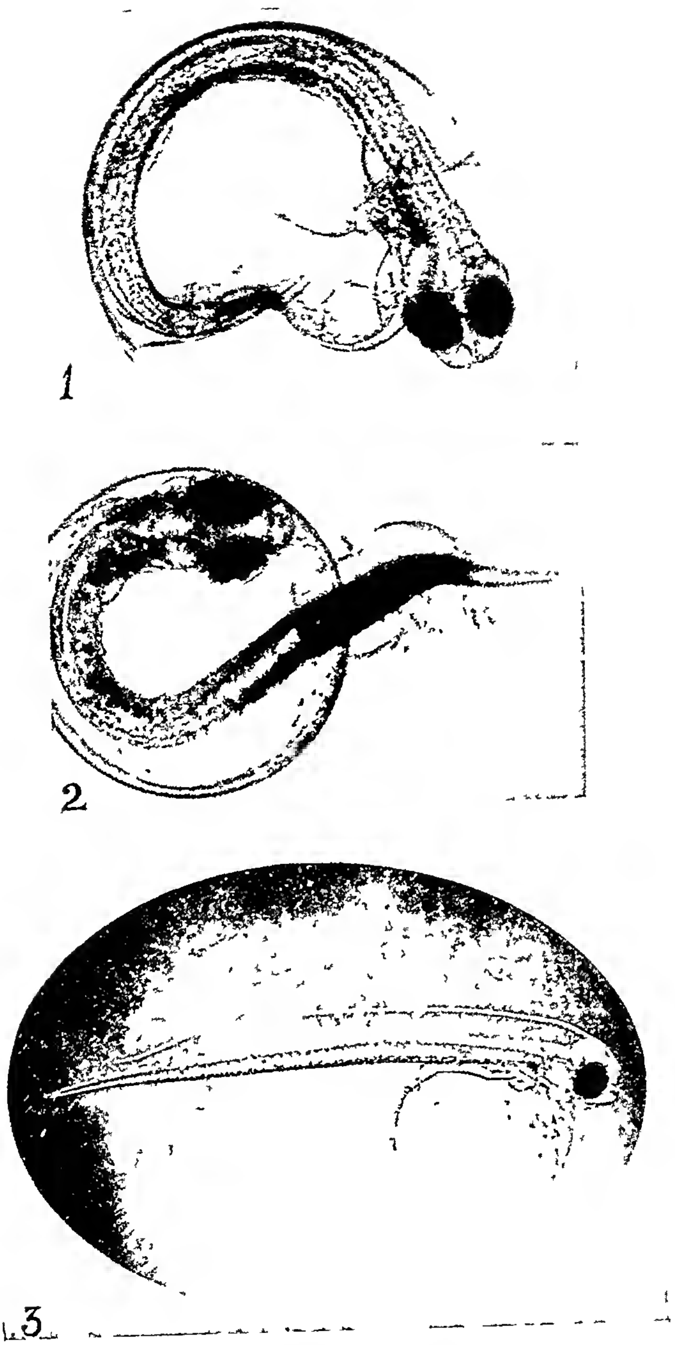
[4] *17th Ann. Rept. Scots. Fish. Bd.*, p. 79, 1898.

The egg of the plaice is buoyant, and one of the largest of the Pleuronectids, being a little less than one twelfth of an inch in diameter It is enclosed in a fairly tough capsule, the outer surface being finely corrugated, and when extruded from the body of the adult female is transparent Before ripening the ovary of the plaice contains opaque eggs considerably smaller than those subsequently extruded In the final stage of maturation before spawning, these small opaque eggs acquire the character of the ripe pelagic egg[1] Fluid of low specific gravity enters the egg, which as a result becomes almost transparent The egg becomes larger, and its specific gravity less The immature ovarian egg is heavier than sea water, whereas the mature egg is very slightly lighter than sea water Intra ovarian changes of this nature are general in the maturation of the ovum of bony food fish and as a result the eggs are pelagic, and float near the surface of the sea when extruded The duration of the spawning period in the case of a plaice is not exactly known According to Johnstone[2] the plaice takes about two weeks to extrude the whole contents of its ovary Later experiments conducted by Fulton show that in the case of plaice kept in confinement the extrusion of eggs was spread over four weeks Fertilisation of the eggs takes place in the sea water into which the eggs are extruded During the spawning season the males and females are crowded together on the spawning grounds, the extrusion of the sperms taking place at the same time as that of the ova

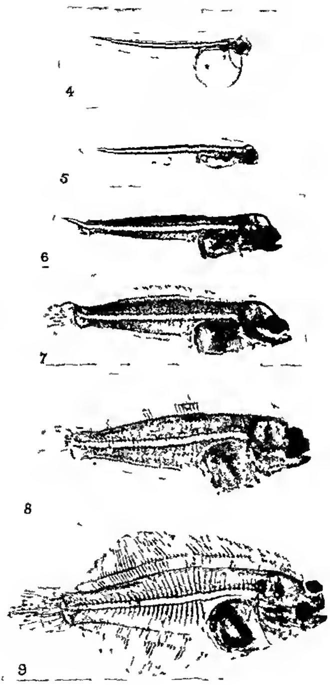
It is difficult to estimate the number or proportion of eggs which escape fertilisation in natural conditions in the sea, but probably the percentage is a very small one, since unfertilised eggs are extremely rarely found[3]

The period of development varies with the temperature, being longer at a lower temperature Eggs fertilised in January at Dunbar hatched in from 16 to 18 days, while those hatched in April had a period of incubation of 8 or 9 days only Dannevig[4] found that at 5 2 C, 21 days were required, at 6 C, 18½ days, at 10 C, 12 days, and at 12 C, 10½ days Among the Pleuronectidæ there is a general correspondence between the size of the egg and the developmental period, other things being equal The flounder with an egg of 095 mm in diameter hatches out in 4½ days at 10 C, while at the same temperature the sole, which has an egg of 1 4 mm in diameter requires 10, and the plaice with an egg of 1 8 mm 12 days For the technical details of embryonic development and

[1] Fulton *16th Ann Rept Scots Fish Bd* Part III p 88 1897
[2] Op cit p 201
[3] *24th Ann Rept Scots Fish Bd* Part III p 281 1906.
[4] *13th Ann Rept Scots Fish Bd* Part III p 147 1894



HATCHING OF THE PLAICE.



GROWTH OF THE YOUNG PLAICE

the larval and post-larval changes reference should be made to special works. Only the briefest summary is given here. When the young plaice hatches out from the egg it is from 6 to 7·5 mm. in total length, and at this stage the large yolk sac attached to the ventral surface is a conspicuous object (Fig. 3, p. 58) and the young fish is symmetrical, i.e. like a young cod or other round fish. For some time after hatching the young plaice continues to live on the food stored up in the yolk-sac. The larval period lasts from the time of hatching until the asymmetrical form of the adult has been attained, which is usually six weeks after hatching. During the first week there is little change except for the gradual disappearance of the yolk-sac, a process generally complete about the eighth day. The larva now takes external food, and is from now on absolutely dependent on it. Possibly this external feeding begins before the yolk has been entirely absorbed. The food of the plaice at this stage is necessarily of microscopic dimensions, consisting of diatoms and larval mollusca.

The young fish grows very slowly, and at the age of twenty-one days from the time of hatching is only about $\frac{3}{8}$ in. in length. After this the length increases relatively slower than the height. The young stages of various crustacea now form its principal food. The tail begins to be bent up at the tip, the fin-rays appearing on the lower or ventral surface. Up to thirty days after hatching the young plaice is symmetrical.

After the thirtieth day the left eye begins to move upwards and forwards, after forty days it appears on the upper margin of the head just in front of the right eye. On the forty-fifth day the left eye has attained its definite position above and in front of the right eye. During the period in which the eyes are rotating the young plaice gradually acquires a new position in swimming. At the completion of metamorphosis the whole symmetry of the head has been profoundly disturbed, though that of the body remains as before, with the exception of the opening of the ureter. The fish finally swims and rests on what is really its left side. The pigmentation now gradually disappears from this side. At this stage of their life-history the young plaice feed on small crustacea known as Copepoda, but larval molluscs and larval crustacea are also eaten. After metamorphosis is complete, the food changes and they feed on various worms (Annelids), and small bottom-living crustacea such as various Amphipods, Mysis and small shrimps. Later the adult food is sought for, and this consists mostly of mollusca of the cockle and mussel family. Detailed reports on the food of plaice[1]

[1] See *Report on the Food of the Plaice*, by R. A. Todd. Board of Agriculture and Fisheries. Fishery Investigations. Series II. Sea Fisheries, Vol. III, No. 3. London, 1915.

and other valuable marine fish are now available

With regard to the rate of growth of the plaice and its length at different ages, it might be as well to explain that there are in general three methods of determining the rate of growth of fish These are —

1 Determination of the size at different ages by means of observations of the rings of growth on the scales

2 Similar observations on the otoliths (ear-stones)

3 To measure the whole of the fish caught in certain hauls where the fish are numerous, and to deduce the growth rate from the grouping of individuals of different lengths

Another method is to keep the fish in aquaria and observe for as long a period as possible the increase of the body length This method is open to serious objection, since the fish are living under artificial conditions, it is not relied on in determining the growth of sea fish

Of the above methods the second and third have been extensively employed in the case of the plaice,[1] whilst the first method has been used for the salmon[2] and herring [3]

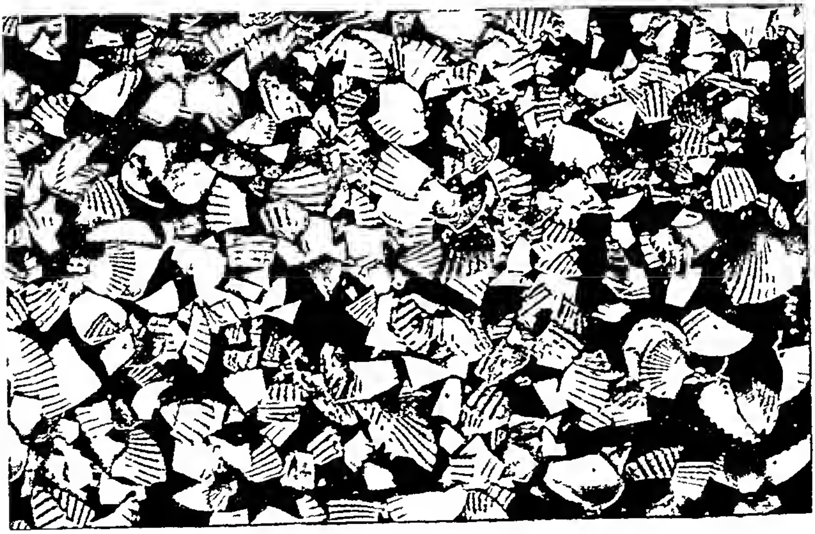
According to Wallace, in the southern part of the North Sea a plaice usually adds as much to its weight in the fourth year of its life as in the first three years combined The greatest average increase in weight probably occurs in the fifth and sixth years, but in the South Dogger region there is a marked diminution in the annual average weight-increment after the fifth year in the case of males, the females on the contrary, show no diminution in the sixth and very little, if any, in their seventh year In the Southern Bight of the North Sea the average length of the three year old plaice is approximately 21 cm for males and 22 for females (about 8½ in) In the Great West Bay the average length of plaice of the same age is 27 cm for males and 28 for females (10¾ inches) The average annual growth is therefore about 7 cm in the first three years in the Southern Bight, and 9 to 9 5 cm in the western part In the fourth year the average increase is 5 5 cm in the Southern Bight, and from 3 5 to 4 cm in the West Bay, so that while plaice grow more rapidly at first in the West Bay, they grow less rapidly subse

[1] There is an enormous amount of literature on the rate *of growth of fish* Reference may be made to W Wallace Report on the Age and Growth rate of Plaice in the Southern North Sea as determined by the investigation of Otoliths Marine Biol Assn Internat Fishery Investigations Second Report (Southern Area) 1907 Cd 3837 p 1 See also Heincke und Henking *Über Schollen und Schollenfischerei in der sudöstlichen Nordsee Aus die Beteiligung Deutschlands an der internationalen Meeresforschung* Berlin 1907

[2] See Board of Agriculture and Fisheries Fishery Investigation. Series I Vol I ' Report on Investigations upon the Salmon with special reference to age determination by study of scales

[3] For a criticism of this method see Rosa Lee An Investigation into the Methods of Growth Determination in Fishes Publications de Circonstance Cons Perm *Internat* Explor de la Mer No 63 November 1912

FOOD OF YOUNG FLOUNDER.
Cockles and "henpens" (*Scrobicularia* and *Mactra*).



FOOD OF YOUNG PLAICE.
Cockles

FOOD OF PLAICE

S zpile [illegible] (1/)

FOOD OF MACKEREL

Young he m t c abs (*Acthreus* z d stage) and Prawns (*Pal aurus*)

quently. In males the advent of maturity is one or even two years earlier than in females.

The fact that sexual maturity is first attained by plaice of different sizes in different parts of the North Sea is one reason why certain investigators have been led to put forward theories of distinct races of plaice. Several such theories have been suggested, some have been modified by their authors as a result of further investigation. It is doubtful whether we possess sufficient information of the biology of the plaice to justify confidence in the existence of " races " of plaice in the North Sea.[1]

Probably the best method of determining the growth and age-groups in the case of the plaice is by measuring large numbers of individuals caught together on the same ground. This method has been followed with success by Johnstone[2] in the Irish Sea, about 16,000 plaice having been examined by him in the years 1909–13.

As a result of these investigations the modal lengths of plaice in the inshore waters of the Irish Sea are given as follows:

Plaice of age-group 0 (that is, over 0 and under 1 year old) are on the average 2¾ inches long.

Plaice of age-group I (that is, over 1 and under 2 years old) are on the average about 5¼ inches long.

Plaice of age-group II (that is, over 2 and under 3 years old) are on the average about 7¾ inches long.

Plaice of age-group III (that is, over 3 and under 4 years old) are on the average 10½ inches long.

Plaice of age-group IV (that is over 4 and under 5 years old) are on the average 13 inches long.

Large numbers of measurements of individual plaice have been made by the English, Scottish and German authorities, not only on the fishing boats, but in the markets as well. Hundreds of thousands of measurements have been recorded and tabulated, and the higher mathematics utilised to clear up the vexed question of the destruction of immature fish.

To give one instance, the Germans have conducted since 1904 a series of " scientific market measurements," that is to say, they have measured and weighed large numbers of representative samples of sea fish landed at the markets by the commercial trawlers. Measurements were also made on board the trawlers of plaice and other fish, so that a comparison might be made between the catches made on the trawlers and the fish landed at the markets. Roughly

[1] See Wallace, " Report on the Age, Growth and Sexual Maturity of the Plaice in certain parts of the North Sea." Board of Agriculture and Fisheries. Fishery Investigations. Series II. Sea Fisheries, Vol. II, No 2. London, 1915.

[2] See especially Report for 1913 on the Lancashire Sea-Fisheries Laboratory, Liverpool, 1914, p. 78, *et seq.*

speaking, about 2½ million kilograms of plaice were captured every year by German fishermen in the North Sea This is equivalent to 2460 tons The number of plaice is estimated to be about 14 millions, and their length varies from 6¾ to 28 in The age of the individual fish ranges from two to twenty-five years, and the average weight is 6 3 oz Of these plaice nearly one-half the total number—i e 7 millions—and nearly one-third the weight are so-called undersized fish They are all under 10 in in length, and under three and a half years old Only 3 per cent of the plaice caught by German fishermen are over 14 in long and five years old The German investigators assert that in order to catch these 14 million fish for the markets a very large number of still smaller plaice from 4 to 8 in long are taken in the trawl nets and hauled on to the trawlers' decks These small fish are not landed in the markets, since they are too small to be marketable, but they are probably either dead or dying before they are returned to the sea At the very lowest calculation not less than from 28 to 30 million young plaice are thus destroyed by German fishermen alone in the North Sea every year These figures are sufficiently alarming even taken by themselves, but if the calculations be extended to include the plaice taken from the North Sea by English and Scottish fishermen, then the total amount of destruction becomes truly appalling In 1913 no less than 237,183 cwt of small plaice were landed in England and Wales, and of these 215 380 cwt were landed on the east coast The "small" plaice landed by the English trawlers certainly number not less than 100 million individuals, and to catch these in all probability another 400 million undersized and unmarketable plaice are destroyed The total quantity of flat fish taken from the North Sea by all countries (except Norway) was estimated in 1905 to be 80,000 tons, and of this 67 2 per cent was plaice

F C

Another method of attacking the problem of overfishing, whether applied to one species only or to fish generally, is to take the statistics of trawled fish landed at a given market during a period of years, having regard to the place and season of capture This has been done for the port of Aberdeen by D'Arcy Thompson In his first paper tables were introduced classifying the whole catch of trawled fish in Aberdeen market during the three years 1905–7, according to the regions from which it was derived; the regions chosen for this purpose being the northern, east coast, middle and south-eastern grounds of the North Sea, the west coast fishing grounds and Faroe and Iceland As the other Scottish trawlers, fishing from the ports of Leith and Granton, Dundee and Montrose, never go beyond the North Sea and seldom very far from port, we have

now reached a point in our statistics where the sources of the supply of Scottish trawled fish can be seen plainly. The tables referred to have been reduced to averages showing the catch of each species of fish per voyage from each of the regions in each year; and to percentages showing the proportion of each species yielded by each area. In the three years (1905–7) the number of voyages increased by about 14 per cent and the total quantity of fish landed by over 20 per cent. Certain species were landed in greater quantity in 1907 than in 1905, e.g. ling, cod, haddock, halibut and lemon sole, but plaice, whiting, witches and brill were diminished by from 20 to 30 per cent, and hake were reduced by more than half. During this period there has been a steadily increasing tendency on the part of the Scottish trawlers to fish at Iceland and Faroe, and also on the west coast, rather than in the North Sea. The number of North Sea voyages fell from 88 to 82 per cent, while those to Iceland and Faroe rose from 3·9 to 7 per cent, from the west coast from 8·1 to 10·8 per cent of the whole. The total catch from the North Sea fell from 77·5 to 64·5 per cent of the whole, while that from Iceland and the Faroes rose from 13·1 to 23·7 per cent. Within the limits of the North Sea itself there was a tendency to resort more to the northern region and less to the middle and south-eastern grounds, including the Fisher Bank, but there was very little diminution either in the number or in the catch of the vessels fishing in the vicinity of the Scottish coast. While the number of voyages to Faroe and Iceland was still comparatively small, the proportionate quantity of fish derived from those regions was large and rapidly increasing in the case of those fish that are more typical of northern than British seas. The average catch per voyage gives a concise series of figures which might be expected to furnish conclusions as to a diminution or otherwise of the available supply. The problem is, however, not so easily solved. In the first place the figures fluctuate greatly, and there is no doubt that some years are less productive than others. The average catch per voyage varied enormously in the case of different species of fish. In the case of plaice the average catch was 28 per cent less in 1907 than in 1905. This may be due to some extent to the change to the more northern fishing grounds. In a subsequent paper D'Arcy Thompson brought the investigation of the statistics of the Aberdeen market up to the end of 1911. The result of these and other statistical enquiries tends to show that it is not easy to answer the simple question whether the supply of fish on our fishing grounds is, or is not, diminishing. It is complicated by the occurrence of seasonal periods of greater or less abundance; it is further complicated by occasional and more irregular periods of increase or decrease; it

is a question that must be put and answered separately for this fish and that, and for this or that fishing ground, and the accuracy of the answer depends on the length of the period under review, and increases greatly with every year over which the statistical enquiry is prolonged In the case of some fish there is already sufficient evidence to enable one to draw general conclusions The cod for instance, shows no evidence of gradual decrease, whereas the plaice exhibits a falling off of the most serious description Professor Thompson deals at length with the sizes of plaice in Aberdeen market according to the various grades of market classification and for various localities of origin It is proved that the plaice from the near grounds off the east coast of Scotland, are smaller than those from any other grounds frequented by the Aberdeen trawlers but nevertheless larger than the average size of plaice landed by the English trawlers at the great English markets In spite of the general expansion of the trawling industry the total landings of plaice at Aberdeen were less than two thirds as large in 1911 as in 1905 The catch of large plaice fell to nearly one fifth of the amount in 1905 that of medium plaice to two thirds, while the landings of small (including extra small) plaice had trebled in amount These extra small plaice are landed in considerable numbers at Aberdeen in the autumn months from grounds which lie near the port They have a median size of rather less than 8 in and over 90 per cent of them are undersized that is below 10 in in length They constitute from 8 to 9 per cent by weight of the plaice landed at Aberdeen, but they only represent about 2 5 per cent in value On the other hand, they represent no less than 32 4 per cent of the whole number of plaice landed The imposition of a size limit of 10 in would put a stop to the present autumn fishing for "extra small plaice," and would exclude about 5 per cent of the small plaice landed The total loss to the Aberdeen market would be about 3 per cent in value of plaice landed and approximately about one thousandth part of the gross value of the whole catch of trawled fish Prof Thompson is strongly of opinion that the destruction of these very small plaice is detrimental to the Fishery, and that it yields no commensurate benefit to the trade

The operations of the Aberdeen trawlers prove that there is a serious diminution of plaice on practically all the fishing grounds, in fact the supply is only maintained by an ever increasing slaughter of immature fish For statistical purposes the areas fished over by these boats in the North Sea are divided into the northern grounds north of 59° N and east of 4 degrees W east coast grounds along the coast from the Orkneys to the Firth of Forth, the middle grounds of the North Sea south of 59 degrees, and the south

eastern grounds, south of 58 degrees and east of 2 degrees E. longitude. With these are grouped certain data not definitely localised called "North Sea various." The clearest way of illustrating the changes is by reducing the annual catch per voyage to a percentage of the mean catch for all the years. Taking this at 100 the proportions in the different years were as shown on p. 67.

This table shows how serious the decline has been in the large and medium plaice, especially in the last few years, while in some of the regions the catch of small plaice increased.

At the first glance the English statistics of the plaice fishery do not appear to support those of Scotland, but when the detailed figures are examined ample evidence of overfishing is discovered. The operations of the English steam trawlers unquestionably indicate an impoverishment of the North Sea as regards plaice.

In 1906 and 1907 the plaice fishery was much the same. Plaice amounted to nearly 11 per cent of the total quantity of demersal fish landed and 98 per cent was taken in the same five regions: White Sea, Iceland, North Sea, English Channel and Irish Sea. Of the total quantity 67 per cent is taken in the North Sea, by far the largest proportion of which comes from the southern part from depths of less than 30 fathoms. The total quantity of plaice landed in England and Wales increased from 853,150 cwt. in 1906 to 966,316 cwt. in 1907.

In 1909 in the North Sea plaice was responsible for 14·92 per cent of the total quantity of demersal fish landed. We have now evidence of a diminution of the stock of plaice in the Iceland region (p. 34). In the North Sea as compared with 1906, the percentage of large plaice has declined from 36 to 21·71 and the percentage of small increased from 31·56 to 46·14.

In 1910 the total quantity landed (941,462 cwt.) was considerably less than in 1909 (1,051,665 cwt.). There was a decrease in the average catch of steam trawlers from the White Sea, Iceland, Faroe and North and West of Scotland, otherwise there were slight increases. The rapid development of the White Sea plaice fisheries, which increased more than sevenfold between 1906 and 1909, was checked in 1910 (p. 33). Even this region, in spite of the great distance from English ports, showed an average catch per day's absence from port for plaice over nineteen times as much as from the North Sea. The latter area still maintains its unenviable reputation for small plaice, this kind still forming no less than 42 per cent of the total. The total and average catch from Iceland is found to be steadily decreasing, and at the same time the proportion of large fish regularly diminished from 59 per cent in 1906 to 36 per cent in 1910. In all regions in which plaice forms an

important constituent of the catch, as in Iceland, North Sea and English Channel the general tendency is for the proportion of large plaice to be diminished during the course of the five years (1906–10) Off Rockall especially, this decrease is remarkable

In 1911 the total quantity of plaice landed from the White Sea was much the same as in 1910, but a great deal more fishing was necessary to make up the total The average catch per day decreased from 46 to 34 cwt , that is 26 per cent As a matter of fact, this fishery reached its zenith in 1909 On the whole, 1911 showed a slight improvement (986,165 cwt) as compared with 1910, but the total was still below that of 1909 The percentage of small plaice landed from the North Sea had by now reached the enormous figure forty-eight

In 1912 (834 271 cwt) there was a considerable decline , every region with the exception of Iceland being affected From the White Sea only 110 848 cwt were landed, this representing 13 36 per cent of the total, a remarkable decline since the previous year, when 255 708 cwt were landed, constituting 25 99 per cent of the total The catch per day s absence fell from 33 72 cwt to 20 15 cwt There are also marked decreases in the total quantity landed, and in the catch per day's absence in 1912 in the Irish Sea, South of Ireland and Bristol Channel

Finally in 1913 the total landings of plaice by first-class vessels fell considerably, and though now a larger percentage of the total was contributed by the North Sea than in 1912, the total landings were, as a matter of fact, less There were decreased landings by vessels of every class, from every region yielding appreciable quantities of plaice except Faroe and the Irish Sea, the largest change being that in the White Sea In this region there can be no doubt that the general stock of plaice has diminished so much during the last few years that trawlers find it hardly worth while visiting the ground " The most experienced fishermen believe, rightly or wrongly, that the plaice stock of the Barents Sea has been so seriously reduced by the operations of earlier years that, except for limited periods, this species can no longer profitably be made the object of a special fishery "[1] As will be seen from the following tables, in 1906 the number of days' absence of English trawlers (steam) in the North Sea was 164 321, and in 1913 147 301 The number of landings by the North Sea steam trawlers decreased in the same period from 26 498 to 25 327 The average catch in cwt of all fish per day's absence from port fell from 17 60 in the former year to 14 08 in the latter Plaice fell similarly from 2 15

[1] Board of Agriculture and Fisheries *Annual Report on Sea Fisheries* for the year 1913 Part I p 6 Cd 7449 London Wyman and Sons 1913

PLAICE LANDED AT ABERDEEN MARKET FROM THE NORTH SEA.
ANNUAL PERCENTAGE OF MEAN CATCH (TAKEN AS 100)

	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.
Northern grounds (North Sea)										
Large plaice	58	180	155	168	183	140	60	28	10	8
Medium ,,	62	198	110	156	127	115	75	67	46	41
Small ,,	36	100	91	145	118	164	136	145	55	27
Total	71	224	171	188	162	144	89	75	47	40
East Coast Grounds—										
Large plaice	160	140	160	140	90	70	70	70	60	40
Medium ,,	124	124	139	95	84	71	93	88	97	86
Small ,,	33	39	47	47	42	33	78	342	136	186
Total	107	107	121	87	76	63	89	140	103	104
Middle grounds—										
Large plaice	140	273	180	140	93	73	33	40	13	20
Medium ,,	122	245	179	155	103	64	32	32	34	32
Small ,,	61	364	61	121	91	61	30	61	91	61
Total	131	269	191	164	109	70	35	36	36	33
South-Eastern grounds—										
Large plaice	54	155	113	93	115	174	112	87	93	7
Medium ,,	82	169	137	105	119	176	72	65	63	11
Small ,,	7	93	85	83	63	81	139	122	174	156
Total	69	157	128	101	111	164	85	74	80	29
Total North Sea—										
Large plaice	88	200	150	146	150	167	58	38	21	17
Medium ,,	100	199	154	118	99	82	71	65	61	53
Small ,,	29	92	71	67	54	63	88	292	113	146
Total	90	187	145	115	100	84	71	89	63	59

in 1906 to 2 09 in 1913 In 1906 the proportion per cent of large North Sea plaice was 36·00 in 1913 it had fallen to 20 33 In the same period small plaice increased from 31 56 to 43 13 per cent

ENGLISH STEAM TRAWLERS IN THE NORTH SEA

	1906	1907	1908	1909	1910	1911	1912	1913
No days absence	164 321	163 596	159 847	147 807	142 269	141 418	142,524	147 301
No of landings	26 498	24 998	24 669	24 362	25 039	26 116	24 855	25 327
Average catch per day cwts	17 60	17 07	16 58	16 95	16 20	16 23	15 76	14·08
Average (plaice) cwts	2 15	2 41	2 36	2 30	2 38	2 57	2 34	2·09

NORTH SEA PLAICE

Proportion per cent

	Large	Medium	Small	Not d st
1906	36 00	24 96	31 56	7 48
1907	25 17	24 18	44 05	6·60
1908	24 99	25 34	41 53	8 14
1909	21 71	28 80	46 14	3 35
1910	21 61	32 60	41 71	4 08
1911	19 15	30·05	48 02	2 78
1912	19 03	32 59	41 52	6 86
1913	20 33	32 39	43 13	4 15

The destruction of these small plaice is confined to about four areas in the North Sea as will be seen on reference to the detailed table below

Percentage of small plaice landed by steam trawlers in England and Wales from certain areas in the North Sea for the period 1906–10

	1906	1907	1908	1909	1910
Eastern grounds (A3)	85 04	89 79	82 80	90 94	85 79
Dutch outer grounds (B3)	44 26	58·06	58 00	61 37	68 60
Eastern grounds (outer) (B4)	78 51	76 88	76 73	84 56	79 22
East of Dogger (C2)	16 47	26·23	32 98	34 56	34 78

Before we pass on to consider the recommendations of the International Council for the exploration of the North and neighbouring seas for the protection of the plaice fisheries of the North Sea it is indispensable to refer briefly to an important investigation carried

out by W. S. Masterman,[1] of the Board of Agriculture and Fisheries. The chief points dealt with in his reports are: (1) Whether an increase or decrease in the stock of plaice in the North Sea can be demonstrated; (2) whether the fish are taken in too great quantities before they reach the best marketable size; (3) whether certain areas, and if so which, form the nurseries for young plaice, and how far young plaice migrate to other areas as they increase in size, and (4) the probable effect of certain regulations for the protection of small plaice. Large numbers of selected samples of plaice from various fishing ports (e.g. Grimsby, Lowestoft, Boston, Ramsgate), landed from all the important grounds in the North Sea were weighed and measured. All trade categories were dealt with, and in addition other investigations such as those into the age-groups and sex were made. An important summary appeared in the third volume of the reports, and this was accompanied by a full and detailed discussion of the question. Unfortunately it is impossible to give more than the briefest outline of Masterman's recommendations here. So far as English steam trawling is concerned, the results of his investigations deal with the possible enactment of one of four size limits, viz. 20, 23, 26 and 29 cm. (e.g. about 8, $9\frac{1}{16}$, $10\frac{1}{4}$ and $11\frac{3}{8}$ in.).

He says that two facts must clearly be borne in mind with regard to a size limit. (1) Unless it prevents trawlers from going into those *areas where the small plaice are to be protected it will serve no* useful purpose, since it is probable that very few of the small plaice if thrown back in the sea, would survive; and (2) the loss of value of the catch must therefore be sufficiently great to force the trawlers to seek their fishing elsewhere than on those grounds, where at certain periods of the year the small plaice are found in great quantities. The above size limits are then considered from these points of view in some detail. With respect to the 20 cm. limit it is evident that, taking the North Sea as a whole, this limit would practically effect nothing with regard to the English trawlers, for while the loss of 0·3 per cent by weight of the catch would not prevent trawlers from fishing, the fact that this comparatively negligible quantity was returned to the sea, even if the fish were all alive, would have no material effect on the supply.

With regard to the next limit investigated (23 cm.), Masterman says that probably it would not be sufficiently high to render fishing unremunerative. The next limit (26 cm.) would probably be sufficient to render it unremunerative to fish in the small plaice areas, especially in the spring and autumn, owing not only to the loss of value, *but also to the fact that many hauls in these grounds*

[1] See Bibliography at end of volume. *Plaice Fisheries*, 4 vols. (p. 285).

consist entirely of small plaice, most of which would have to be discarded and the labour and risk would add to the actual loss in percentage The limit of 29 cm is considered to be needlessly high, especially for the initial experiment. He concludes, " It remains to be seen, when the results of the investigations of other countries are ready for comparison, what limits are found practicable for their own interests, and for an adjustment to be made by mutual consent "

One of the main objects of the International Council for the exploration of the North and neighbouring seas from a fishery standpoint, was the investigation of the life history of the plaice, and a special Committee of the Council was established for this purpose The Committee met from time to time, and at a general meeting of the Council held at Copenhagen in September, 1913, the results of the plaice investigations came up for consideration It was thought that a sufficient protection of the young of the plaice would best be obtained by imposing an international size limit of from 25 to 26 cm Having regard to the interests of the plaice fisheries of the various countries it was, however, considered advisable to commence with a somewhat lower size limit, as fixing an international limit would be in the nature of an experiment

These considerations had been confirmed at a conference of the Plaice Committee previously held in London (June, 1913) At this Committee consideration was given to the summary of Professor Heincke's general report,[1] and all the other available evidence upon the plaice and plaice fisheries of the North Sea The conclusions and recommendations of the Plaice Committee adopted by the International Council were —

(1) There has been for many years a decrease in the larger sizes of plaice in the North Sea

(2) The number of small plaice shows great natural variations from year to year, and this is expressed in the landings of plaice

(3) The number of plaice of the smaller sizes in the landings has increased There has been a recent tendency in some cases to bring to market smaller sizes than previously

(4) It would be desirable in the interests of the fishermen and of the public generally that these smaller sizes of plaice should be preserved on the grounds until they have grown to a larger and more valuable size

(5) The most effective method of doing this so far as steam trawling is concerned, would probably be by direct closing of the

[1] Investigations on the plaice General report by Dr F Heincke I Plaice fishery and protective measures Preliminary brief summary Conseil perm internat Copenhague 1913

nursery grounds, but the Committee is of opinion that the difficulties of carrying out such a measure internationally would be very great, and the best practical remedy is the imposition of a minimum size limit.

(6) As an initial measure, and in order to meet the different conditions of the plaice fishery in each country, a minimum size limit of 20 cm., below which it would be illegal to land plaice, should be imposed.

(7) Considering that the destruction of small plaice occurs chiefly in the spring and summer months, a size limit of 22 cm. should be in force for the months from 1st April to 30th September in each year.

(8) As it is essential to ascertain the effects of such measures the International Council is requested to make provision for the necessary investigations.

In arriving at the above conclusions the Committee were evidently endeavouring to compromise. In Holland there is at present a size limit of 16 cm. for plaice, and it is desirable that this size limit should be increased. In the British Isles there is no minimum size limit for the plaice, and the proposed size limits of 20 and 22 cm. would have little immediate effect in checking the operations of the steam trawler, while their sudden imposition would press hard on the smaller class of inshore fishermen. In Denmark the size limit for plaice is 8 in., and as a consequence plaice caught by Danish fishermen which are too small to be landed in their own country are landed and sold at Billingsgate. Generally speaking, in Germany plaice less than 15 cm. in length from end to end may not be caught, that being the size limit in East and West Prussia, Pomerania, Mecklenburg-Schwerin, Lubeck; but in Schleswig-Holstein, Hanover and the free towns of Hamburg and Bremen the limit is 18 cm. The Plaice Committee took into consideration the fact that during the autumn and early winter the plaice in several regions of the North Sea are in good condition before they attain the size of 22 cm., and that the local fishing circles could not stand a too drastic limitation of their former practice. Therefore they decided unanimously that from October to March an international size limit of 20 cm. should be proposed. Having regard to the fact that some countries have no official size limit or a considerably lower one than that recommended, it did not appear advisable to propose higher limits at first. "The primary object was, above all, to make it possible for all countries participating in plaice fisheries of the North Sea to unite in joint protective action." The Committee defined the area within which their recommendations should first take effect (practically the whole of the

North Sea), the sizes of fish which it should be made illegal to land, and the conditions under which the regulations should be applied. Details are given in the report already referred to

These proposals were under consideration by the various Governments interested in the plaice fisheries of the North Sea when war broke out in August, 1914 Naturally there can be no concerted international action for the protection of the fisheries of the North Sea for some years, and the possibility of individual action by any of the Governments is very remote There can be no doubt that all the scientific and statistical evidence is in favour of some further protection for undersized fish, especially flat-fish (Pleuronectids) Whether a size limit is the best measure of protection is a moot point. In all probability it is not, and the International Council seem to have recognised this, since they advocate as "the most effective method" of protecting the plaice, the closure of the nursery grounds Before considering the effect of a legal size limit for plaice on the inshore fishermen, reference must be made to a paper by Dr Masterman on the plaice fisheries of the North Sea (October, 1915), as it summarises the most recent official investigation of the Board of Agriculture and Fisheries into this question [1] Masterman analyses the plaice statistics for the period 1906–12 so far as they relate to English landings from the North Sea The southern plaice fishery is carried on chiefly by sailing trawlers from Ramsgate and Lowestoft, and this fish is the chief object of these vessels, as it constitutes 57 per cent by weight of their catch The plaice fishery in the northern parts of the North Sea is conducted by steam trawlers, whose movements are not mainly influenced by the prevalence of this species

Just as in the case of soles in the Irish Sea, the plaice of the southern North Sea are absolutely essential to the continuance of sailing trawling Steam trawlers, on the contrary, are not dependent on any single species of fish In the North Sea, for instance, where plaice are abundant, haddock are scarce, and vice versa Either species can be captured by the steamer, but the distance of the latter from the home ports of the sailing trawler render its capture practically an impossibility Even although the plaice can only be considered vital to the sailers, its importance to the steamers is, nevertheless, considerable On the whole, Masterman's conclusions support those of the Scottish investigators, even although he may not be quite so outspoken as to the probable results of this overfishing on the future of the fisheries There can be no question but

[1] Board of Agriculture and Fisheries Fishery Investigations Series II Sea Fisheries *Vol II No 1* *Report on the Plaice Fisheries of the* North Sea (Parts I and II) by A T Masterman London 1915

that fish which was formerly thrown overboard as being too small for the market is now being landed. At Grimsby there is a new trade class of plaice called " small small." But this cannot account for the great increases in small plaice landed at the English North Sea ports during the period 1906–12, and there seems to be no doubt that the plaice available are gradually undergoing a reduction in size, an infallible index of overfishing. Masterman's conclusions and results confirm this. There is a moderate decrease in the total quantities of plaice landed both from the northern and the southern North Sea, chiefly due to a reduction in the amount of fishing and partly to a change of fishing ground. There is a marked decline in the landings by weight of the larger and older plaice, both absolutely and relatively to the total quantities of plaice landed ; and at the same time a marked increase in the landings by weight of the smaller and younger plaice, both absolutely and relatively to the total quantity of plaice landed. The extent of these decreases and increases may be seen from the following tables :—

North Sea. Large Plaice

DECREASE IN LANDINGS (ENGLAND) IN PERIOD 1909–12 AS COMPARED WITH 1906–9

	Number of days absent. Per cent.	Quantity landed. Per cent.	Catch per day's absence. Per cent.	Proportion per cent to total plaice.
Sailing trawlers .	18·33	42·18	29·29	39·11
Steam trawlers . (single boaters)	10·38	29·03	20·81	24·27

Single boaters are steam trawlers which land their own fish and do not transfer them at sea to special steamers (carriers) whose function it is to run to market with the fish.

North Sea. Small Plaice

INCREASE IN LANDINGS (ENGLAND) IN PERIOD 1909–12 AS COMPARED WITH 1906–9

	Number of days absent. Per cent.	Quantity landed. Per cent.	Catch per day's absence. Per cent.	Proportion per cent to total plaice.
Sailing trawlers .	18.33	13·69	37·84	19·73
Steam trawlers . (single boaters)	10·38	10·79	23·61	18·22

The objections to a size limit are so serious as to vitiate any proposals of the kind. In the first place it is impossible to fix a size limit high enough to give any effective protection to any known

fishing ground outside the territorial area frequented by small plaice The territorial waters can always be, and as a matter of fact are, dealt with by closure or other regulation There will probably always be sufficient fish of other species, together with a few plaice over the size limit (which would naturally be "salted judiciously in the packing with those just under the size), to make trawling pay on these offshore grounds The International Council themselves realise the absurdity of fixing even so low a limit as from 25 to 26 cm (say from 10 to 10½ in), so they wish to commence with from 20 to 22 cm (8 to 8½ in) This should be contrasted with the various minimum size limits proposed to the House of Commons' and Lords' Committees in 1900 and 1904 The chief scientific witness representing the Marine Biological Association, in his evidence before the House of Commons Committee of 1900, said that a size limit for plaice would only be effective provided the minimum was 13 in The size advocated by the National Sea Fisheries Protection Association was, as in 1893, 8 in for plaice

Before the Committee of 1904 another scientific witness said that ten years ago (in 1894) "I thought the size limit should have been 13 in" Then, curiously enough, he argues that as the average size has decreased, that is to say the larger fish have become less plentiful, a smaller limit might be as efficacious as a larger limit ten years ago [1]

A curious example of fallacious reasoning Since overfishing has gone on sufficiently in ten years to reduce the average size of fish on certain grounds in the North Sea, a less measure of protection is now as useful as a greater measure of protection would have been before the diminution was brought about The witness evidently forgot that the size limit is intended to protect fish below, and not above, that size It may be stated with confidence that the fishing trade in this country will never tolerate a 13 in minimum size for plaice, or even anything approaching 13 in It would require much actual financial loss to the steam trawler owners before even the idea of a 10 in limit would be entertained So the International Council started wisely enough with a limit that might prove acceptable to all parties, i e 8 in (for winter) and 8½ in (for summer), for North Sea plaice, with the recommendation that "These regulations should not hinder any country in introducing higher size limits for plaice than those named, or in extending the area of prohibition to ports or other parts of the coast not in the North Sea" Would the imposition of such a low size limit be of any advantage to the fisheries generally? It is open to very grave doubt.

[1] Report from the Select Committee on the Sea Fisheries Bill (H L.) 1904 See answers to questions 1119 1120

On the other hand, would it inflict any hardship on the fishermen? On the inshore fishermen it would, and for that reason one is compelled, though with reluctance, to object to the proposal. Already the English and Welsh inshore fishermen have to bear the burden of sea fishery legislation, since the regulations are only operative within the territorial waters. Much of this legislation is of an amateurish description, framed by bodies which knew little, and confirmed by a body which knows less, of the manifold and intricate problems concerning the sea fisheries. Fortunately there is a marked tendency to relax or abolish much of this ill-considered and hasty legislation. It would be a matter for regret if further burdens were placed on the inshore fishermen, especially when it cannot be proved clearly that such burdens would be to the public advantage. The limit proposed by the International Council is not high enough to prevent the steam trawlers from fishing on any of the grounds known to be frequented by immature plaice, and the sole effect of the measure would be that some proportion of the small and extra small plaice which is at present sold in our markets will be dumped over the trawler's side before her return to port. The only result then so far as the steam fishing boats are concerned, is that fishing will go on as before, the smaller fish will continue to be caught and killed, the difference being that they will now be destroyed uselessly, whereas there was some slight utility in their previous destruction, since they served ultimately as human food. The effect on the inshore fisheries will be quite different and the proposed regulation is likely to affect seriously the inshore fisherman. Here a digression is necessary in order to explain that, in the English and Welsh territorial waters, the sailing trawlers can only fish subject to local regulations, the chief of which is a proviso that the mesh of the trawl nets be not less than a certain prescribed minimum, usually 6 in. measured round the four sides of the square. While this is far from being an ideal measure of protection, since immediately outside the territorial waters fishing is unrestricted, it certainly does prevent the destruction of a large number of fish that are in any case far too small to be marketable. The addition of an 8 or 8½ in. measure of length will prove a serious handicap to these inshore fishermen, probably sufficiently serious to compel them to stop fishing altogether.

A careful and detailed study of the plaice and plaice fisheries of the Irish Sea has been made by Dr. Johnstone.[1] In this area the most important plaice grounds frequented by the inshore fishermen

[1] See various Reports of the Lancashire Sea Fisheries Laboratory, edited by Prof. Herdman, C. Tinling and Co., Liverpool, and particularly the report for 1913, p. 122, *et seq.*

and the smacksmen are the Nelson Buoy (estuary of the Ribble) the Horse Channel (estuary of the Mersey) and the Redwharf and Beaumaris Bay grounds From the analysis of a large number of measurements of individual plaice taken on these grounds Johnstone concludes that the imposition of a size limit of 20 5 cm (8 in) for plaice would deprive the fishermen of the following proportion of all the fish caught in the trawl

IRISH SEA PLAICE

PERCENTAGE OF TRAWL CAUGHT FISH UNDER 8 IN

	Nelson Buoy (R. Ribble)	Horse Channel. (R Mersey)	Beaumaris and Redwharf Bays
January	—	—	23
April	—	54	—
May	67	54	—
June	58	69	42
July	50	51	37
August	39	28	38
September	45	28	36
October	43	28	59
November	—	—	27
December	—	—	20

If it be made illegal to land plaice in the summer months less than 22 cm in length then the following percentages of the present catch of the summer plaice fishery between Blackpool and the Liverpool Bar will be useless to the fishermen

LANCASHIRE COAST SUMMER PLAICE FISHERY

PERCENTAGES OF TRAWL CAUGHT PLAICE UNDER 22 CM ($8\frac{3}{4}$ IN)

May	June	July	Aug	Sept	Oct
76	74	70	62	62	53

Johnstone argues that the adoption of a size limit would differentiate in favour of one class of fishermen An 8 in size limit would prevent about one half of all the fish caught on the Nelson Buoy grounds from being landed Presumably such legislation has for its object the prevention of trawling on such a ground as this the argument being that the fishermen would refrain from fishing on such small plaice grounds if they were prevented from landing the bulk of the fish caught These particular grounds are mainly fished by the inshore fishermen from second class half-decked boats The imposition of a size limit can only be justified by assuming that the fish which would otherwise be taken will remain alive in the sea

migrate to other grounds and grow to a size at which their commercial value is much higher. This migration occurs, but it is unlikely that all the fish which would be saved by the size limit would migrate to fresh grounds and grow at the normal rate. In the first place natural causes will be at work diminishing the stock, and secondly the thinning-out of the plaice population on these and similar grounds probably leads to the more rapid growth of the survivors. If these Nelson Buoy fish were protected by a size limit what would happen? They would migrate offshore and be caught by the first-class sailing trawlers or the steamers. If then over 8 in. they could be marketed, if under they would be uselessly destroyed, since the offshore grounds would yield other classes of fish sufficient to make trawling remunerative, even if a large proportion of the plaice were undersized.

If it could be proved that the destruction of undersized plaice was due mainly to the inshore fisherman, then there would be some justification for putting an additional burden on him. But a study of the statistics shows that it is the exact opposite which is true, i.e. it is the steam trawler which is responsible for the destruction. The three important areas from which small plaice are landed by English and Welsh fishing boats are the North Sea, Irish Sea and English Channel. The following table shows the proportion landed by steam trawlers, first-class sailing trawlers and second and third-class boats respectively.

Occasionally a small catch of plaice is landed by a steam liner and included in the above totals, but not in the detailed figures. The discrepancy is, it will be seen, very slight and does not affect the argument.

Alternative methods which have been suggested for the maintenance of the supply of plaice are artificial hatching and transplantation. The hatching of sea fish may well claim a share of our attention, since it is based on the assumption that the fish population of our seas is falling off owing to over fishing, and that it is possible to remedy this decline by artificial means. In Europe marine hatcheries have been established by the Norwegian Government at Flodevigen for cod[1] and at Drontheim for plaice, by the Scottish Fishery Board at the Bay of Nigg, by the Manx Government at Port Erin, and by the Lancashire Sea Fisheries Committee at Piel. These institutions are not entirely devoted to the hatching of sea and shellfish, but are also equipped for scientific research, and in the Scottish and Lancashire hatcheries fishermen's classes

[1] For details of the work done at the Norwegian hatchery see, *The Utility of Sea-Fish Hatching*, by G. M. Dannevig. Proceedings of the Fourth International Fishery Congress, Washington, U.S.A., Bulletin U.S. Bureau of Fisheries, Vol. XXVIII, 1908. Govt. Printing Office, 1910.

NORTH SEA—SMALL PLAICE

ALL FIGURES ARE CWTS. (see p. 77, line 25)

	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913
Steam trawlers . .	147,928	243,261	190,895	207,175	163,231	196,382	161,278	146,677
1st class sail . .	32,054	43,086	62,071	65,092	47,353	59,887	57,674	61,384
2nd and 3rd class boats .	561	394	689	1,060	1,182	1,597	1,033	1,232
Total . . .	180,544	286,741	253,658	273,327	211,771	257,866	219,985	209,293

IRISH SEA—SMALL PLAICE.

ALL FIGURES ARE CWTS.

	1906.	1907	1908.	1909	1910.	1911.	1912.	1913.
Steam trawlers . .	165	193	287	642	4,327	5,796	5,429	6,887
1st class sail . .	183	90	198	71	35	264	1,028	609
2nd and 3rd class . .	2,156	4,271	5,186	6,133	6,467	9,690	4,332	8,445
Total . . .	2,504	4,554	5,671	6,846	10,829	15,750	10,789	15,941

ENGLISH CHANNEL—SMALL PLAICE

ALL FIGURES ARE CWTS.

	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
Steam trawlers . .	226	384	583	746	842	1,034	1,345	1,277
1st class sail . .	1,114	2,669	2,781	2,816	3,074	3,363	3,305	2,353
2nd and 3rd class . .	2,433	2,799	3,088	2,637	2,458	2,480	2,223	2,036
Total . . .	3,773	5,852	6,452	6,199	6,374	6,877	6,873	5,666

are established for the purpose of instructing fishermen in marine biology and navigation (for the Board of Trade examinations for skippers and second hands). The accounts relating to the building, equipment and upkeep of these institutions are not easily available, and it would in any case be difficult to estimate what proportion of the expenditure should be allocated to the hatching operations.

It has been repeatedly claimed on behalf of these institutions that results of direct economic importance have accrued from their operations, but, in fact, it would be difficult to justify their continued existence on that ground alone. As a matter of fact, these hatcheries are merely adjuncts to institutions devoted to marine research and to the education of fishermen.

These institutions are devoted to the hatching of various species of sea fish, including plaice, lemon soles, turbot, cod and lobsters; and it should be noted that, unlike similar fresh water establishments, no attempts at rearing the fish have up to the present been successful. It would appear from various criticisms that have from time to time been published, notably those of Fryer[1] and Hensen[2], that these hatcheries have been instituted without due inquiry into the occurrence of eggs and larvæ of fish in a state of nature; no efforts have been made in this country to determine the "census" of the sea, if indeed such an operation is possible; the only inquiries that have been made on an extended scale into the quantitative determination of fish eggs and larvæ are those of the Germans, who have, as a result of their observations, taken up a firm attitude against sea fish hatcheries. It need hardly be pointed out that the qualitative observations that have been carried out in this country as to the determination of floating organisms, inclusive of fish eggs, afford no firm basis for generalisation into the relative abundance of the plankton from year to year. In fact, the quantitative results obtained abroad are open to the serious criticism that they may not be fair samples of the floating population of the seas, but, at any rate, they serve to indicate the lines on which research should have been prosecuted before expenditure was incurred on schemes of rather doubtful utility.

It would appear that the bulk of the hatching operations are directed to the attempt to increase the supply of plaice; and during the twelve years ending 1913 the Scottish Fishery Board liberated 226 million fry of the plaice. The Annual Report of the Marine Biological Station at Port Erin for 1914 gives a total for the season's

[1] *12th Ann. Rept. of the Inspectors of Sea Fisheries (England and Wales)*, p. 29, 1898.

[2] *Wissenschaftliche Meeresuntersuchungen.* N.F. Bd. II. Heft. 2. Kiel, 1897, p. 71.

hatching of 7,707,350 plaice larvæ liberated; no other fish are now dealt with at these institutions[1] At the Lancashire Committees Sea Fish Hatchery at Piel about one million plaice and 10 million flounder fry were liberated in 1914

Another claim put forward in favour of the hatchery is that it serves as a reserve of spawners The number of spawners in the various hatcheries is not always given In the Scottish Report for 1913 there is no statement as to the number of adult plaice in the spawning ponds, but in the ponds attached to the hatchery at Port Erin there were 350 healthy plaice The condition of these fish which are confined under artificial conditions is probably less favourable than it would be in a state of nature In some of the hatchery reports we learn that "very few fish had died," and in others, "There is always a certain amount of natural mortality among them, particularly during the summer" The mortality rate among spawners is nowhere expressed as a percentage The claim that the hatchery provides a reserve of spawners or confers immunity on a number of spawners will not bear detailed examination Not only is there a mortality—the percentage of which is unpublished—once the fish are put into the ponds, but there must inevitably be a considerable mortality before the fish get to the spawning pond Special hauls are made by the scientific steamers for the purpose of obtaining these fish, and the mortality that takes place during the trawling, the time the spawners are kept on the steamer, and during transference to the spawning pond should also be taken into account

The theory that the spawning pond acts as a reserve of breeding stock may, therefore, be dismissed, the probability is that the percentage of mortality of these fish if left in the sea (from being captured by commercial trawling and from their natural enemies) is less than it is in the spawning pond, where the fish are detained under artificial, i e unnatural conditions In how many hatcheries are the spawners kept from year to year? Attempts have been made from time to time to obtain spawn from fish caught in commercial fishing (see p 252) The writer has a vivid recollection of the difficulties of collecting spawn from steam trawlers in the Irish Sea in the spring of 1899

A further point urged by the advocates of sea fish hatching is that there is an enormous mortality of eggs and larvæ in the sea While on à priori grounds the statement that there must be an immense destruction of eggs or larvæ or post larval fish is indisputable, there is no clear evidence of the enormous destruction of pelagic eggs of marketable fish in nature It may safely be said that

[1] Except lobsters at Port Erin

no one knows what proportion of fish eggs and larvæ are destroyed in a state of nature.

In defence of fish hatching "the risks of non-fertilisation" in a state of nature are touched upon. Here again there are no definite statements as to the percentage, if any, of non-fertilised pelagic fish eggs in the sea. In fact, authentic records of unfertilised eggs are either non-existent or of the greatest rarity.

Although there is a great mortality in a state of nature somewhere in the life history of the plaice, we have no logical reason for believing that the period of maximum mortality is tided over in the hatchery.

It may be taken for granted that there is a considerable mortality in the sea. There is no evidence to show that this occurs before hatching, it possibly or even probably occurs after hatching, i.e. subsequent to the stage at which the larvæ are set free from the hatchery. No supporter of fish hatching, however enthusiastic he may be, can conscientiously say that the thread-like larvæ at present liberated are at all capable of protecting themselves.

Another theoretical objection urged against the artificial propagation of sea fish for economic reasons is based upon consideration of the vast area of the sea as compared with lakes and rivers, and upon the enormous fecundity of most sea fish, especially those, which like the plaice, produce pelagic eggs. But as Fulton,[1] in an able and impartial paper on the subject, has pointed out, although the extent of the sea is vast, the parts frequented by edible fish—the fishing grounds on which the fish are caught—are relatively small, usually confined to the neighbourhood of coasts or to banks in close propinquity to them. Of recent years much information has been obtained with regard to the migrations of several valuable species, and we now know that, with regard to plaice, at any rate, the extent of wandering is, especially in the early years, very small. In the case of marked plaice liberated by Fulton in the Firth of Forth and St. Andrew's Bay, and by Meek on the Northumberland coast, nearly 90 per cent of those recaptured were taken within a few miles of the place of liberation, sometimes after an interval of two years or more. The fact that the natural range of certain species may on the whole be quite restricted, materially modifies the application of the argument based on the vastness of the sea.

In combating the argument against artificial hatching of sea fish based on the enormous fecundity of most edible marine species, Fulton to some extent supports our contention as to the fact that "there is not sufficient information to enable one to apportion with

[1] "The Loch Fyne Experiments with Plaice," by Dr. T. Wemyss Fulton, *26th Annual Rept. Scots. Fish. Bd.*, Part III, Glasgow, 1909. Cd. 4454.

exactness the relative destruction that takes place in the egg stage and in the larval stage, or in the later stages "

" It would be of value in this connection if a large body of accurate information existed to show the relative proportions of the eggs, larvæ and post-larvæ of the food-fishes existing under natural conditions in the sea "

Sea fish hatching is attended with difficulties not present in the case of fresh water or anadromous species No one doubts that in areas of water under more or less complete control, piscicultural operations may be beneficial and profitable Carp and oyster culture are instances But where the areas are extensive, as in the open sea or the great lakes of North America, or where rivers are concerned, as in the culture of salmon, the conditions cannot be controlled, and indisputable evidence of success is most difficult to obtain An increase following hatching operations may be due to natural causes or even to other kinds of artificial interference such as fishery regulations

In spite of the absence of definite statistical evidence of the success of fish hatcheries it is to be noted that certain fishery authorities are extending their operations in this direction from year to year A notable instance is that of the United States of America, to whose work reference is made in the last chapter Although a large part of the fish culture of the United States is devoted to fresh water and anadromous forms, the Commissioner of Fisheries is evidently not discouraged with the results of their marine work In a recent report[1] he says, with reference to the marine species, " Unusual numbers of cod are reported all along the coast, and surprising catches have been made on inshore grounds In spite of the growing scarcity of adult lobsters and the ruthless destruction of young and eggs during the last ten years, fishermen on the New England coast have been finding in their traps many more young lobsters than formerly , flat-fish are much more numerous, especially small flat-fish, in the shallow waters along shore "

In Canada, Professor Prince,[2] the Commissioner and General Inspector of Fisheries for the Dominion, reports, " Public opinion is indeed favourable in the highest degree to the expansion of artificial fish breeding in its various branches, and the Federal Government has not been slow to recognise the desirability of extending hatching operations "

It is only fair to mention that in the United States and Norway the fishermen in the neighbourhood where the fry have been liberated

[1] ' Report of the Commissioner of Fisheries for the Fiscal year ending 30th June, 1906 p 5

[2] *40th Annual Report of the Department of Marine and Fisheries 1907 p 232*

have frequently stated their opinion that the hatcheries are beneficial in increasing the supply of fish, and in years of abundance they attribute the increase to the operations of the hatchery. Fulton states that at certain parts of the coast of Aberdeenshire the line fishermen, who annually petition for supplies of plaice fry from the Scottish Fishery Board Hatchery at the Bay of Nigg, have also expressed the opinion that the liberation along the coast has increased the number of plaice in the inshore waters. The inshore trawlers of Morecambe Bay in Lancashire go even further. They say they can distinguish the plaice hatched and liberated from the Lancashire Sea Fisheries Hatchery at Piel, Barrow, from the local race. The fish hatched from Piel are of Scottish origin, their parents being obtained from the closed waters of Luce Bay. Although, personally, one is sceptical as to this, there can be no doubt of the existence of this opinion, which is strongly held by a large section of these trawlers. It must not be forgotten that fishermen may support hatcheries as an alternative to restrictive legislation, apart altogether from the respective merits of these two methods of increasing the supply of sea fish.

Dr. Fulton points out that the results of fish hatching operations may be tested in one of three ways. Either (1) by the introduction of a fish not indigenous to the region, or (2) by a system of special statistics of the fish caught in the region over a series of years when no fry were added to the waters, and over another series of years when fry were liberated; or finally (3) by special investigations to determine the abundance of the young fish in years when fry were added and in years when they were not added.

Unfortunately there is no available evidence under the first heading for marine fish, though there is very striking evidence in the case of an anadromous fish (the American Shad).

This fish was formerly non-existent in the Pacific, but in 1871 a consignment of 12,000 fry, about eight days old, from the Hudson River on the Atlantic coast, were put in the Sacramento River by the California Fish Commission. In 1873 another consignment of 35,000 fry were added; in 1876, 99,000; in 1877, 110,000; in 1878, 150,000; and in 1880, 215,000; the total being 621,000 shad fry. From these small colonies amounting to less than 1 per cent of the number now annually planted in the Atlantic slope rivers, the shad have multiplied and distributed themselves along nearly 3000 miles of the coast from southern California to south-eastern Alaska. An adult shad is said to have been taken in 1873, and sixteen were taken in 1874 and 1875; in 1876 and 1877 they had become quite common in the Sacramento River, and some were found along the coast over an extent of 400 miles. In the spring of 1879 several

thousand mature shad were sold in the market at San Francisco and in 1886 the California Fish Commission estimated that a million good-sized shad were taken in the waters of the State, in 1895 it was reported that the shad was one of the most abundant fishes of California, the quantity taken being enormous In recent years the fish has become so abundant that the price has gone down enormously, being often less than a cent per pound, and of the tons taken in the salmon-seines nearly all are now thrown back into the water or used as manure

With the view of ascertaining the effect of the liberation of the fry of the plaice, considerable numbers of them were transferred to Loch Fyne from the hatchery of the Scottish Fishery Board in the years 1896–1901, and a few months later the abundance of the young plaice found in certain localities in the loch was tested by fishing with a push-net on the beach In the six years 1903–1908, no fry were placed in the loch, and the push *nettings were continued at* the same places and at corresponding times in order to determine the abundance of young fish in the same way The total number of the year's plaice which were obtained was 13 068, the collective results in the two periods being —

	Number of fry liberated	Number of hours fishing	Number of plaice	Average number per hour
1903–1908	142 880 000	74	6 491	87 7
1896–1901	none	165½	6 577	39 7

It will be seen that in the first period when plaice fry were being put into the loch the average number of young plaice taken was 87 7 per hour, whereas in the second period, when no plaice fry were added, the average number taken per hour was 39 7, or less than *half* The average at each of the five stations where collections were made was less in the second period than the first, the decrease per hour ranging from 19 2 to 104 7 The collections were made in the months of *June, July, August* and *September*, and *the mean number* of young plaice taken per hour was less in each month in the second period than in the first, and with one or two exceptions this was true of each of the stations considered separately The fluctuations from year to year were very considerable, the mean annual average ranging in the first period from 24 to 174 and in the second period from 8 to 112 When the average was high at one station or in one month, it was also, with few exceptions, high at the other stations and in the other months, and similarly when it was low, therefore the numbers represent approximately an actual abundance or scarcity of the young plaice in Loch Fyne in the particular years

The period of thirteen years over which these experiments have extended is a considerable one, and Dr. Fulton thinks it is reasonable to believe that the greatly increased average abundance of the young plaice in the first years was mainly due to the liberation of the fry from the hatchery; and that, on the other hand, the decrease in the abundance in the last six years was mainly owing to the fact that no plaice fry were added to the loch in those years.

The transplantation of young plaice from one ground to another has been suggested as a means of increasing the yield of the plaice fisheries of the North Sea. The question was discussed at a Conference of representatives of the sea fishing industries of the United Kingdom, convened by the National Sea Fisheries Protection Association at Grimsby in 1902, and again at a subsequent Conference held at Aberdeen in 1905. Apparently the idea of transplanting young plaice to a suitable feeding ground originated in Denmark, where certain experiments were carried out by Petersen,[1] who transplanted young plaice from the North Sea to an inland lagoon known as the Thisted Bredning. Fish so transplanted were reported to have increased in growth in a remarkable manner.

In the North Sea experiments on the transplantation of small plaice from shallow inshore grounds to the richer feeding ground of the Dogger Bank, were first carried out by the Marine Biological Association in 1904. The rapid growth of the fish thus transplanted, when compared with the growth of fish of similar sizes remaining on the inshore grounds, was described by Garstang[2] in one of the earlier reports on the North Sea investigations of the Marine Biological Association. Similar experiments were carried out subsequently in each year up to and including 1908, and the results are summarised in an elaborate memoir by Borley.[3] The rapid growth of the plaice transplanted to the Dogger Bank was repeated in each year, and although its amount varied slightly the whole series of experiments places the reality of the increased growth beyond reasonable doubt.

If the results of all the Dogger Bank experiments for the years 1904–8 are combined, the average growth in length of the plaice recaptured one year after liberation is $5\frac{1}{4}$ in., the average initial size of the fish transplanted being about $8\frac{3}{4}$ in. The fish have thus grown from an average size of $8\frac{3}{4}$ in. to an average size of 14 in. in one year. Had they remained on the inshore grounds from which they were taken the annual growth would have been only 2 in.

[1] Reports from the Danish Biological Station, VI, Copenhagen, 1896.

[2] "Experiments in the transplantation of small plaice to the Dogger Bank. International Investigations," *M.B.A. Report*, I. (Cd. 2670, 1905.)

[3] "Report on the experimental transplantation of plaice to the Dogger Ban.k International Investigations," *M.B.A. Report*, IV. Southern Area. (Cd. 6125, 1912.)

If the weights be considered the results are even more striking A combination of the results of all the experiments shows the average growth in weight of the transplanted fish one year from the date of liberation amounts to 382 per cent of the original weight Similar fish on the inshore grounds only increase their weight by 100 per cent in a year

The transplanted plaice had thus increased their weight by about 3¾ times that which would have resulted from their normal growth on the coastal grounds The increase in weight of the transplanted fish is accompanied by a more than proportionate increase in value, since weights being equal, large plaice are more valuable than small According to estimates based on the prices for the principal trade categories in England, at the end of one year from the date of liberation the fish recaptured almost equal in value all those set free, while those still at liberty are worth about 5½ times (565 per cent) as much On another estimate based on more detailed prices obtained from Denmark, a year's recaptures are worth 166 per cent, and those remaining in the sea 993 per cent of the total value of all the plaice originally transplanted There is reason to believe that had all the plaice dealt with remained on the coastal ground, unmolested throughout the whole year, their value would have increased to about 3 3 or 4 3 of their initial worth according as English graded prices or Danish detailed prices are considered Within two years of liberation the transplanted fish actually returned were at least from two to three times as valuable as all those liberated, and probably more These estimates are only approximations and their acceptance is subject to certain qualifications, they are, nevertheless, based on trustworthy data and cannot be ignored The growth of the transplanted fish takes place most rapidly in the summer months, but it is shown that on the Dogger Bank a certain amount of growth occurs even in the winter, when growth on the inshore grounds has practically ceased A considerable proportion of the fish remain on the Bank for a year or more, and these fish grow even more rapidly than those which wander off it The principal migration off the Bank takes place when the fish become mature for the first time, and they are then found on the spawning grounds, particularly on those off the Yorkshire coast As time goes on the transplanted fish gradually become distributed over the different fishing grounds of the central and southern North Sea, particularly over those which lie to the south and west of the Dogger Bank These transplanting experiments, though interesting as a scientific experiment, are hardly practicable on a commercial scale

THE SOLE (as a type of flat-fish).

Although the plaice is the most important flat-fish to the fish trade in the British Isles, yet the sole occupies in several respects so remarkable a position that some reference to it, however brief, is indispensable.

The sole is by far the most highly priced sea fish, and it is also the only demersal fish which is still caught in larger quantities by sail than by steam trawlers, though the latter are fast overtaking the former. In 1913 the weight of soles landed in England and Wales was 66,766 cwt., of which 29,675 were landed by steam trawlers, 32,957 by sailing trawlers (first class) and 3962 by sailing trawlers of the second and third class. There can be no doubt that apart from the sole, sailing trawling would fail to provide its votaries with sufficient remuneration to enable them to make a living; though it is true that at certain times of the year they depend on other fish such as the plaice. Nothing is more certain, on the west coast, at any rate, than that the failure of the sole supply would lead to a collapse of sailing trawling.

In its broad features the life-history of the sole resembles that of the plaice. There are, of course, several kinds of fish sold—some legitimately and some illegitimately—under the designation sole. There are four species of sole commonly met with in British waters, but of these the solenette (*Solea lutea*) is too small to be marketable. It is, however, a common feature of the shrimper's catch, where it is frequently mistaken for the young of the true sole. Of the three edible species the common sole (*Solea vulgaris*) predominates enormously. The writer has witnessed hundreds of hauls with the trawl off the west coast at varying depths and at all times of the year. In most of the hauls, made from all classes of fishing vessels, soles have been present, but only on a few occasions, certainly less than half a dozen, was the French sole or sand sole (*Solea lascaris*) met with; and the thickback or variegated sole (*Solea variegata*) never. These two species are probably more abundant on the other coasts, but they must constitute an insignificant portion of the British catch of soles. The sole is a southern species and is not included in the fishery statistics of Scotland, Sweden or Norway. Occasionally soles of the genera Synaptura and Cynoglossus are to be met with in British markets; they are caught by steam trawlers on the grounds off the coasts of Portugal and Morocco. Frequently soles are sold under local names, for instance, at Chester as "Parkgate soles," or at Manchester as "Southport soles," these are generally true soles, even if not from the locality specified. Soles sold with any other qualification are almost certainly not the true sole, the "lemon sole" (*Pleuronectes microcephalus*) is a case in point.

The sole differs from the plaice in its spawning habits The former spawns in somewhat deeper water than the latter, and the spawning areas are more localised In the Irish Sea there are three well-defined areas in which spawning soles are found in great numbers in the spawning season Two of these areas have been heavily fished by steam trawlers in the spawning season for the last few years, and signs are not wanting that the third ground is also being exploited

In the North Sea it appears to spawn in depths of about 22 fathoms (which corresponds closely with the Irish Sea sole), off the Dutch and Belgian coast from the middle of April to the end of June, May being the principal month

The body of the sole is much more flexible than that of the plaice, and the sole escapes easily through the meshes of a net which will retain a plaice of equal size and weight This body flexibility renders the marking of the sole a difficult operation and does not facilitate artificial hatching In fact, the artificial hatching of the sole on even a moderate scale has not hitherto been successful in the British Isles To this the depth of water at which the sole naturally spawns, and the difficulty of obtaining milt from the males are also contributory causes The sole is nocturnal in its habits, and is caught more frequently at night than by day, and in the daytime more frequently when the water is cloudy than when clear It seeks its food more by sense of smell and touch than by sight, and in the Irish Sea, at any rate, prefers worms (Nereids) to any other form of diet

An estimate of the quantity of soles landed in Northern Europe for the years 1903–07 has been made by Redeke and Tesch, of the Marine Biological Station at the Helder In this table the quantities are given in metric tons of 1000 kilograms

AVERAGE CATCH OF SOLES, 1903–07

	Total quantity	Value, £s.	Quantity from North Sea	Percentage for each country
England	3762 6	469 116	2250 7	69
Holland	520 3	63 969	520 3	16
Belgium	359 7	40 153	304 5	9
Germany	268 9	29 838	181 6	5
Ireland	159 4	12 515	—	—
Denmark	116 6	9 359	26 6	1
Total	5187 5	624 950	3283 7	100

From 1903–07 the greater portion of the catch went to English fishermen, and the largest quantity came from the North Sea English fishermen still land the largest share of soles, but the North

Sea lost its superiority in 1909, as compared with all other regions, and has never since regained it. (See Appendix, p. 281.) In 1906 the North Sea yielded 61·68 per cent of the total English and Welsh catch. In 1909 the North Sea percentage was 46·76, this being the first year that the North Sea percentage was less than 50. In 1911 the North Sea percentage was 40·89, but by 1913 this had increased to 45·38. The Irish Sea catch of soles increased from 4·86 percentage of the whole catch in 1906 to 22·13 in 1913. Similarly the Bristol Channel percentage increased from 10·65 in 1906 to 16·99 in 1913, but the English Channel catch remained practically stationary in this period (10·88 to 10·90).

The statistics of the sole fisheries do not as yet give so certain evidence of overfishing as those of the plaice fisheries.

THE HADDOCK (as a type of demersal round fish)

The cod family, to which the haddock belongs, is one of the greatest importance to British trawlers and liners. In reality, though so unlike in external appearance, there is a close zoological relationship between the cod family and the plaice family. At least seventeen members of the cod family are met with in abundance in British seas, and of these no less than eight are landed in sufficient quantities by British fishermen to justify their being recorded separately in the official statistics. Just as there are five species of the genus Pleuronectes separately recorded, so are there five members of the genus Gadus. These are the haddock (*Gadus æglefinus*), the cod (*G. morrhua*), the whiting (*G. merlangus*), the coalfish (*G. virens*), and the pollack (*G. pollachius*). The total quantity and value of these five species landed in the British Isles in 1913 is appended :—

WEIGHT IN CWTS. (1913)

	England and Wales.	Scotland.	Ireland.	Total.
Cod . . .	2,646,666	1,233,449	20,381	3,900,496
Haddock . .	1,553,869	730,104	10,292	2,294,265
Whiting . .	427,262	223,745	7,236	658,243
Coalfish . .	363,499	410,985	—	774,484
Pollack . .	12,893	—	—	12,893

VALUE IN £S (1913)

	England and Wales.	Scotland.	Ireland.	Total.
Cod . . .	1,700,931	583,451	15,737	2,300,119
Haddock . .	1,334,519	549,711	6,775	1,891,005
Whiting . .	280,329	105,179	5,472	390,980
Coalfish . .	118,125	78,491	—	196,616
Pollack . .	8,819	—	—	8,819

The "headquarters" of the haddock in the North Sea is in the central portion, in comparatively deep water Here the spawning grounds of the haddock are situated, and the fish are found in greatest density, as regards both number of individuals and total weight of fish caught per fishing day Haddock are less abundant further south, both in the North Sea and on the west side of the British Isles In Icelandic waters and off the Faroes they are very abundant Russell[1] believes that the supply of haddock in the North Sea is more or less self contained, and that there is no great interchange between this and other regions In this respect the haddock is like the plaice, indigenous to the North Sea, spending the whole of its life within its boundaries For some considerable time the absence of the small haddock in the shallow inshore waters in which young cod, coalfish and other gadoids are found, was a puzzle to ichthyologists, and it is now known that they are to be found in abundance in the deep water of the northern North Sea

The haddock spawns in the northern North Sea in March and April, where the young fish remain for the first two years of their life As they get older they migrate outwards They move about in shoals, which consist of individuals of approximately the same age and size It is probable that there are certain periodic movements and concentrations of these shoals for feeding and spawning purposes, especially a movement southwards in the summer time, and a return northwards in the winter

The haddock, like all other members of the cod family, has pelagic eggs The egg is the largest found amongst the Gadoids, and the spawning period is the earliest The number of eggs produced by a mature female in a season may be averaged at about 450,000 There is a great similarity between the eggs of the Gadoids and the Pleuronectids, and this similarity is paralleled in the development, except for the change in symmetry in the latter family

Haddock, like plaice, are divided into trade categories for market purposes At Aberdeen[2] there are four classes, known as Extra Large, Large, Medium and Small, to which of recent years a fifth class known as Extra Small has been added The average size of these five groups of fish is about 24, 16, 14 12 and 9 in , or 60, 40, 35,

[1] Board of Agriculture and Fisheries Fishery Investigations Series II Sea Fisheries Report on market *measurements in relation to the English haddock fishery* during the years 1909–11 by E S Russell Vol I Part I Report 1914 Wyman and Sons London Vol I Part II appendices 1914 Wyman and Sons London

[2] North Sea Fisheries Investigation Committee Third Report (Northern Area) Fishery Board for Scotland Statistical Papers Cd 4350 Wyman and Sons London 1908 Paper by D Arcy Wentworth Thompson On the Statistics of the Aberdeen Trawl Fishery 1901–6 with special reference to the cod haddock and other round fishes pp 217–280

30 and 23 cm. The extra large haddock come in great quantities from Iceland and the Faroe grounds, whence come the largest fish of all. The largest haddock recorded from Faroe was 82 cm., or 33 in.; from Iceland 89 cm. or just about a yard long. Off the east coast of Scotland and in the middle North Sea grounds, haddock of this extra large class are rare, but a certain number come from the Shetlands, from the western grounds, and from the south-eastern grounds. The large haddock are found in greatest numbers off the north-west coast of Scotland and also towards the Danish coast. Small haddock are more plentiful in the middle regions of the North Sea, but the statistics are defective because quantities of them are thrown away by the trawlers and not brought into port. The extra small haddock chiefly come from the grounds nearer Aberdeen. There are four trade categories at the English ports, i.e. large, medium, small and very small. The average size varies a little at the different ports. The usual range for very small is from 15 to 29 cm., and for small from 24 to 40 cm.

Unfortunately the method of recording the locality of capture differs in England and Scotland, and naturally this does not facilitate the study of the complete statistics of an individual fish. In Scotland the system of statistical investigation now in general use was devised by Fulton in 1891. As summarised in his paper it consists essentially in recording for each vessel landing (1) the place where the fish were captured; (2) the duration or extent of the fishing operations by which they were taken; (3) the date; (4) the particulars of the kinds and quantities of fish landed.

These statistics were published by the Fishery Board for Scotland for the Aberdeen trawling fleet up to February, 1903, since which time they have been taken over by the International Committee. The delimitation of the regions or areas under which the statistics are summarised is most important; for without such delimitation the statistics would be valueless. To divide the North Sea into four or five large areas would be quite misleading. The areas chosen by Fulton were the squares formed on the chart by the intersection of each degree of latitude with every second degree of longitude, each of the areas, which was numbered, having an area of 3600 sq. miles. This system was convenient, but has one disadvantage; it takes no account of the depths.

The system adopted by the English Board for the division of the North Sea has already been described. The areas are mapped according to the depth of water, and some of the areas were further subdivided and numbered. These areas vary in size from 62 to 28,106 sq. miles, and are also of very irregular and diverse shape. Much has been said for and against each system.

Two Scottish reports have recently been published which deal with, *inter alia*, the statistics of haddock landed in the Aberdeen market The first report deals with the trawl fishery for the period 1901–6, the second for the years 1908 to 1911 inclusive In the first report tables are submitted showing the average quantity of each species of fish caught, and in the case of haddock the various sizes distinguished in the market returns, per 100 hours' trawling, within each of the numerous areas of the North Sea, off the west and north-west of Scotland and at Faroe and Iceland

A study of these statistics shows clearly that seasonal variations are markedly periodic, each species having its annual seasons of scarcity and abundance more or less constant in each area, more or less diverse in the different areas At the same time the degree of relative scarcity and abundance in the different seasons varies with the species Underlying these annual fluctuations well marked differences sometimes exist between one year and another, there are years of scarcity and years of plenty At this stage the statistical investigations fail to give a definite answer to the apparently simple, but really difficult, question whether the supply of any species of fish is or is not diminishing

The statistics show that 30 per cent more haddock were landed in 1907 than in 1905 When mean values for three consecutive years are compared (1905–7, 1906–8, etc), it is found that the decline in haddock for the whole period, comparing 1905–7 with 1909–11, is 20 per cent for large, 21 for medium, 29 for small and 24 per cent for the total quantity of haddock landed On the other hand, extra small haddock increased by 64 per cent Most of this increase is probably caused by fish being saved which in former years was thrown away

The detailed English statistics go back to the year 1906 During the period 1906–1913 the average catch of haddock for steam trawlers in the North Sea shows a startling diminution —

NORTH SEA HADDOCK

	1906	1907	1908	1909
Average per day (cwts)	7 82	7 82	6 90	5 84
Number of days absence (steam trawlers)	164 321	163 596	159 847	147 807

	1910	1911	1912	1913
Average per day (cwts)	4 84	5 28	4 69	2 99
Number of days absence (steam trawlers)	142 269	141 418	142 524	147 301

The following table shows how serious is the decline, not only in

North Sea haddock, but in the total yield of the haddock fishing grounds accessible to English fishing vessels.

ENGLAND AND WALES

WEIGHT IN CWT. OF HADDOCK LANDED

	By first-class vessels from North Sea.	All vessels from all grounds.
1906 . . .	2,046,204	2,820,424
1907 . . .	2,119,939	2,862,776
1908 . . .	1,749,009	2,532,283
1909 . . .	1,453,304	2,223,552
1910 . . .	1,296,062	2,039,479
1911 . . .	1,382,476	2,114,287
1912 . . .	1,293,080	1,972,338
1913 . . .	928,285	1,553,869

The localities where the destruction of small haddock by English steam trawlers takes place, are shown in the following table :—

PERCENTAGE OF SMALL HADDOCK, 1906–10

	1906.	1907.	1908.	1909.	1910.
North Sea					
The Dogger (B1) . .	60·02	51·39	33·22	31·98	44·67
East of Dogger (C2) .	63·60	50·49	28·43	23·18	42·35
West of Dogger (D1) .	71·85	67·22	59·26	57·12	63·23
Great Fisher Bank (D1) .	64·49	73·57	67·47	52·09	36·42
West-Central area (E) .	71·66	76·07	73·33	64·47	51·31
Northern area (F1) .	72·58	84·61	89·10	79·21	61·19
North Sea (whole area) .	64·02	56·60	48·43	47·05	48·96
West of Scotland . .	54·80	56·48	49·93	43·86	46·44

As far as quantity was concerned, haddock in 1906 occupied the first place in demersal fish landed in England and Wales, forming 33·46 per cent of the whole catch. Nearly three-quarters of this species were caught in the North Sea ; in this area haddock formed nearly half of the total catch. In 1907 the results correspond very closely with those for 1906. In 1907 haddock constituted nearly 32 per cent of the total catch of demersal fish ; and nearly 96 per cent of this fish came from four areas : Iceland, Faroe, North Sea and West of Scotland. The quantity landed from the North Sea was, as in 1906 about 75 per cent of the total. In 1908 there was a diminution of 14·5 per cent in the catch of haddock as compared with 1906. The average catch per day's absence by steam trawlers also fell in this time by nearly 12 per cent. In 1909 the North Sea yielded only 66 per cent of the total catch of haddock, though this

fish was still the most abundant demersal species in that area, forming 36 69 per cent of the total catch

The average catch per day's absence of steam trawlers in the North Sea fell from 7 82 cwt in the years 1906 and 1907, to 6 90 in 1908 and to 5 84 in 1909 The proportion of haddock to the total catch of demersal fish in the North Sea fell from 47 per cent in 1906 to 37 per cent in 1909 The decrease in the total landings shown in 1909 continued in 1910 In every region, with the exception of the White Sea, Iceland and west of Ireland, there has been since 1906 a diminution of the average catch of steam trawlers, the main source of the supply of this species Haddock, which in 1906 formed one-third of all the demersal fish landed, had fallen in 1910 to only 23 per cent In 1911 there was a slight recovery, mainly due to the North Sea The year 1912 was the worst recorded at English and Welsh ports since the new method of collecting statistics was inaugurated This marked decline of the haddock fishery extended to all the important regions with the exception of Faroe and West of Scotland The catch per day's absence for steam trawlers has now fallen considerably in most regions, notably in Iceland and the North Sea Even from the Faroe grounds, which report an increase, the advance is entirely due to an increased catch of small haddock, the catch jumping from 9084 cwt in 1911 to 37,102 in 1912 The decline in haddock was accentuated in 1913, which shows the lowest total since 1904 The proportion of haddock to total demersal fish has now sunk to 18 6 per cent, and the total quantity landed was some 418,500 cwt less than in 1912 The falling off is nowhere more marked than in the North Sea, although there is a decrease in the landings from all regions of importance, with the exception of Faroe and Rockall Generally speaking, the average catch per day has decreased, the fall in the case of the North Sea being 36 per cent

THE HERRING (as a type of pelagic round fish)

Most fishermen believe that the herring performs seasonal migrations of vast extent The old idea was of annual migration from Arctic waters southward along our east and west coasts, and this was held to be the reason why the fishery is later the further south one goes It is much later, for instance, at Yarmouth than at Thurso or Wick It is improbable that the herring of Yarmouth belong to the same shoals as those of Thurso or Wick, since the fish are found to be spawning at widely different seasons of the year According to Pennant[1], "The great winter rendezvous of the

[1] *British Zoology* Vol III 4th Edition 1776 p 335

herring is within the Arctic Circle; there they continue for many months in order to recruit themselves after the fatigue of spawning." After describing the separation of the shoals into the eastern and western "brigades," Pennant goes on to say, "Were we inclined to consider this partial migration of the herring in a moral light, we might reflect with veneration and awe on the mighty Power which originally impressed on this most useful body of His creatures, the instinct that directs and points out the course, that blesses and enriches these islands, which causes them at certain and invariable times to quit the vast polar deeps and offer themselves to our expecting fleets. That benevolent Being has never, from the earliest records, been once known to withdraw this blessing from the whole, though He often thinks proper to deny it to particulars; yet this partial failure (for which we see no natural reason) should fill us with the most exalted and grateful sense of His providence, for impressing so invariable and general instinct on these fish towards a southward migration, when the whole is to be benefited, and to withdraw it only when a minute part is to suffer."

Although much time has been devoted to the investigation of the habits and life-history of the herring since Pennant wrote the above, there is still much that is obscure in the movements of the shoals of this the most abundant and valuable of our food fish.

The egg and young, and some of the spawning grounds are well known; and, as will have been gathered from the preceding pages, the herring is remarkable in that it is practically the only commercial species of bony marine fish which has demersal eggs, that is eggs which are laid on the bottom and there undergo their development (Fig. 96).

Even the other members of the herring family, such as the sprat and pilchard have pelagic eggs. The egg of the herring varies from 0·92 to 1 mm. in diameter, and the average number of eggs carried by an adult female is about 30,000. This is quite a moderate number for a marine fish and is far below that produced by most pelagic-egg producing species. In most districts where herring abound there is evidence of two main spawning seasons, one in the spring and the other in autumn, and this fact has given rise to the theory that there are two main races of herring, spring and autumn-spawning herring. This question of the races of the herring will be briefly touched upon later.

The development of the herring does not present any exceptional features, and since it is described in some detail in the works of Cunningham[1] and McIntosh,[2] further reference to it is omitted here.

[1] *Marketable Marine Fishes.* London, 1896.
[2] *British Marine Food-fishes.* London, 1897.

The best summary of our knowledge of the rate of growth of the herring is contained in a paper by Fulton,[1] published by the Scottish Fishery Board

According to Fulton the herring grows very slowly, and the investigators who supposed that it reached the mature condition in a year or eighteen months are much mistaken At the end of the year in which it was hatched the spring herring rarely exceeds a length of 2 in, and the great majority are much smaller, at the same period the autumn herring may be a little over ½ in, and is rarely over 1⅜ in

This difference between the spring and autumn herring persists throughout Growth in length, as with most fishes, is somewhat more rapid in the early stages, diminishing with age, at first slowly and on the occurrence of sexual maturity, with great and marked rapidity *Herring, both male and female, appear to attain the mature condition and to reproduce for the first time* when the age is five years The elucidation of the question of the growth of the herring has an important bearing on fishery problems Compared with demersal fish, the herring caught by drift nets has a great advantage in the struggle for existence, since four generations of undersized and immature herrings escape through the meshes In a trawl these immature fish would be captured

Neither the spawning grounds nor the spawning habits of the herring are well known There are different theories as to the intervals between the successive spawning times of the herring Heincke[2] is of opinion that the spawn has never been found twice in the same year on the same spawning ground which would be the case if the same herring spawned twice annually Cunningham[3] directly contradicts this, since he says that two spawnings have been definitely observed in the same neighbourhood Matthews[4] also believes that the herring spawn twice in the same year He believes that the herring spawning off Ballantrae in February and March, and those which spawn off Campbeltown in spring, and then enter Loch Fyne in the summer as spent herring, become ripe there and spawn for the second time from August to the end of October If this view be correct there would be no distinction between spring-spawning and autumn-spawning races, at any rate, of this part of the coast of Scotland

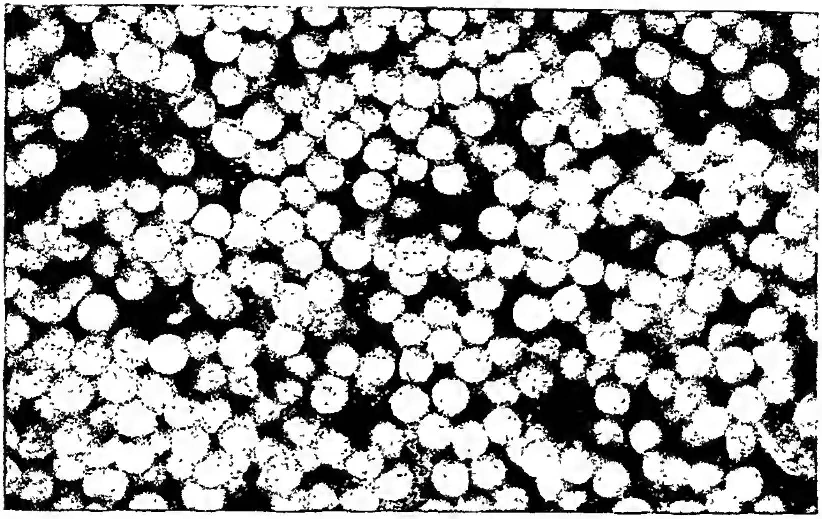
Another theory has been held as to the interval between suc-

[1] On the growth and age of the herring *24th Ann Rept Scots. Fish Bd*, Part III p 293

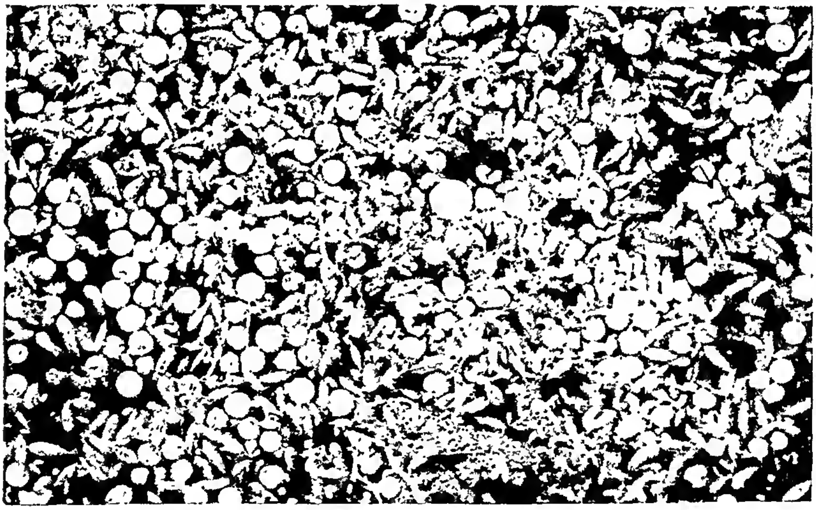
[2] *Naturgeschichte des Herings* Berlin 1898 Text p 47

[3] *Marketable Marine Fishes* London 1896 p 151

[4] *Fourth Ann Rept Scots Fish Bd* p 61

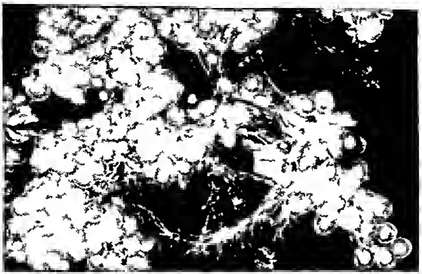


HERRING EGGS ON LAMINARIA.

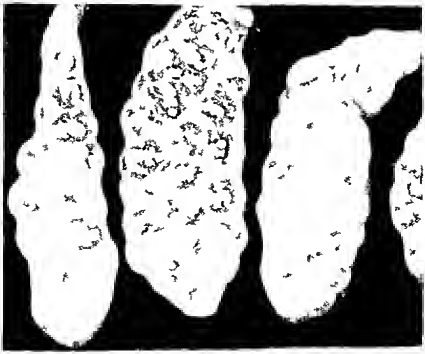


PLANKTON CONTAINING FISH EGGS.

The large Egg is that of a Plaice. The smaller ones are Cod and Whiting.
The Copepod is a Calanus.



EGGS OF SHELLFIS TURRITELLA
(ak by F h m (F h Egg)



SPA VN OF THE SQUID
(F equen y ak n n he aw)

cessive spawning periods. The Scandinavian[1] and Danish writers believe that a period of eighteen months elapses between the spawning periods, in which case the spring herring of one year would become the autumn herring of the next, and so on. Heincke contests this view. He argues that if the interval between two successive spawning periods exceeded one year then we should get an equal distribution of spawning herring in all months of the year. This argument loses much of its force if the interval were approximately eighteen months, since there would then be two principal spawning periods, spring and autumn.

Since the capture of the mature herring is the occasion of an enormous fishery, we possess a great deal of information of the appearance of the mature fish on our coasts (see p. 47). It is, therefore, a matter for some surprise that the spawning grounds are not well known and have not been determined with any exactitude. In certain cases limited areas have been explored, the eggs of the herring collected and the development of the young studied. The first investigation of this kind was that undertaken by Allman,[2] who was deputed by the Scottish Fishery Board to investigate the herring of the Firth of Forth. He found the spawn of the herring on rough rocky ground near the Isle of May, at depths from 14 to 20 fathoms. These eggs were attached to stones, shingle, shells and other objects on the sea bottom. Since then the spawn of the herring has been obtained from other localities, notably from the Ballantrae Bank in the Firth of Clyde,[3] where large numbers of herring eggs have been dredged up from a gravelly bottom in comparatively shallow water. A still more striking instance is that of the Baltic herring which spawn off the Danish island of Langeland in depths of from 1 to 4 fathoms, or even enter the mouth of the River Schlei,[4] where the writer has observed them spawning in brackish water at depths of only a few feet. The eggs of the herring have been collected in this locality attached to the submerged portions of a fresh water plant (*Potamogeton pectinatus*). It is a remarkable fact that the herring can maintain itself in arms of the sea which have been permanently shut off from the main ocean and in which the water has become practically fresh.[5]

[1] Trybom; *Sillundersökningar ved Sveriges Vestkust.* Hösten, 1888. *Berättelse till Kongl. Civildepartementet.* Stockholm, 1889, p. 12. Smitt, *Om Sillrasernas betydelse. Bihang till K. Svenska Vet. Akad. Handlinger.* Band 14. Afd. IV. No. 12. Stockholm, 1888, p. 13.

[2] Royal Commission on Herring Trawling, 1863.

[3] See "Natural History of the Herring," by J. Cossar Ewart, *2nd Ann. Rept. S.F.B.*, published 1884.

[4] See also paper by Kupffer (1878), and Meyer (1878) in the Jahresbericht der K. Commission, Berlin.

[5] See Jenkins, "Altersbestimmung durch otolithen bei den Clupeiden," Wiss. Meeres. Abt. Keil., N.F. Bd. 6, 1902, p. 110.

The question of races of herring is one of great interest, being still the subject of investigation Heincke[1] has carried out a most laborious and painstaking investigation of the body-differences of different samples of herring obtained from most of the fishing grounds of Northern Europe, and as a result he announced that he was able to distinguish two main groups of herring, namely Spring or Coastal herring and Autumn or Sea herring The main differences between these two groups may be summarised thus —[2]

	Number of vertebræ	Belly scales	Belly scales between Head and ventral fin	Belly scales between Ventral fin and anus
Spring or Coast Herring	51–57	36–46	24–31	11–17
Autumn or Sea Herring	55–58	33–48	26–32	11–20

	Ventral fin	Lateral length and height of head	Spawning period
Spring or Coast Herring	Nearer head	Less	April and May Brackish water
Autumn or Sea Herring	Nearer tail	Greater	August to Feb Salt water

Not only did Heincke claim to be able to distinguish these two main races, but he also stated that he had proved the possibility of separating a larger number of local groups, each with its distinguishing characters According to this view a race of herring frequents a particular spawning ground, returning there every year to spawn The question is so important that it is necessary to examine the evidence on which Heincke's results are based

At the commencement of his work he made body measurements of the herring with regard to four characteristics Subsequently these were extended to include a larger number, he found, nevertheless, that the four originally chosen gave him the most important results

These four characters are —

1 Distance of the dorsal fin from the end of the snout Measured from the end of the snout with the mouth closed to the root of the first fin ray of the dorsal fin "D" in Heincke's Tables

2 Distance of the ventral fin from the end of the snout Measured from the end of the snout with the mouth closed to the root of the first fin ray of the ventral fin "V" in the Tables

[1] Op cit

[2] Compiled from Die Fische der Ostsee" von Möbius u Heincke Berlin Paul Parey 1883 pp 136 and 137

3. Distance of the anus from the tip of the snout. "A" in the Tables.

4. Length of the base of the anal fin. From the root of the first to the root of the last fin ray of the anal fin. "An" in the Tables.

From these four measurements Heincke believed that he could distinguish spring from autumn-spawning herring, provided a sufficiently large number of individuals were taken and the average calculated, otherwise the individual variation would be too great.

The characteristics are always expressed by Heincke as relative and not as absolute measurements, and they are expressed as a ratio of the total length, inclusive of the caudal fin.

A comparison of a large number of measurements showed that

1. The distance of the dorsal fin varied from 2·08 to 2·47
2. „ „ ventral „ 1·97 to 2·28
3. „ „ anus „ 1·41 to 1·65
4. The length of the base of the anal fin from 12·5 to 7·5

In order to make comparisons easier the ratios expressing the distance of the dorsal fin from the tip of the snout are divided into four groups, each of which is distinguished by a number :—

1. When the ratios varied from 2·08 to 2·17
2. „ „ „ „ 2·18 to 2·27
3. „ „ „ „ 2·28 to 2·37
4. „ „ „ „ 2·38 to 2·47

In a similar manner each of the other ratios was divided into four groups with the exception of the distance of the anus, which was divided into five. To each of these groups descriptive numbers or letters were applied, viz. :—

Distance of ventral fin.		Distance of anus.		Length of anal fin.	
a.	1·97 to 2·04	0	1·41 to 1·45	A	80 to 92
b.	2·05 „ 2·12	I	1·46 „ 1·50	B	93 „ 105
c.	2·13 „ 2·20	II	1·51 „ 1·55	C	106 „ 118
d.	2·21 „ 2·28	III	1·56 „ 1·60	D	119 „ 131
		IV	1·61 „ 1·65		

Heincke next stated that spring herring could be designated by the formula 2bII and the autumn herring by the formulæ 2aI or 2aII.

In the first place it should be noted that the formulæ do not express what they are intended to, and that it is quite possible that they can convey false impressions.

For instance, it is quite possible that two groups of spring herring, to each of which Heincke's average formula 2bII applies, are really

much more unlike one another than one of them is unlike a group of autumn herring to which Heincke s formula 2aI applies

This difference may theoretically be very great, as may be seen on reference to the following table —

Formula		Indices D	V	A
2bII	Spring herring	2 18	2 12	1 55
"	"	2 27	2 05	1 51
2aI	Autumn herring	2 27	2 04	1 50

In every respect the second group of spring herring is more like the autumn herring group than it is like the first group of spring herring

That this discrepancy actually occurs in Heincke's work may be seen on reference to the following table —

	Indices			
	Formula	D	V	A
Tab 108* 13 Spring herring from the Dollart	2bII	2 27	2 12	1 54
Tab 136† 24 Spring herring from Stralsund	2bII	2 20	2 05	1 53
Tab 143‡ 35 Autumn herring from Gothland Bank	2aII	2 20	2 03	1 53

* *op cit* Tab u Taf p 123
† 149
‡ 156

From this it appears that the spring herring from Stralsund resemble the autumn herring of the Gothland Bank much more than they do another group of spring herring from the Dollart, and the difference between the two groups of spring herring is nowhere more marked than where the formulæ are similar, that is, in the case of the distance of the *ventral fin* It would have been far better to have employed, instead of an arbitrary formula, either the averages themselves or to have effected a comparison by means of curves based on these averages

Then it would be possible to form a true conception of the actual relationship of the various groups of herring which Heincke investi gated, which is practically impossible under present conditions

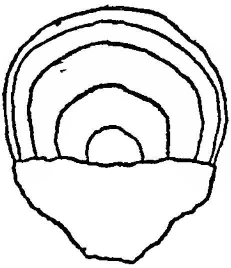
Heincke's own investigations gave the following results In the case of spring herring, fifteen tables dealing with separate groups yielded the correct average formula 2bII, i e 65 per cent, whereas eight tables gave a different formula, i e 35 per cent In the case of autumn herring, seventeen tables gave the correct formula 2aI

or 2aII, i.e. 60·7 per cent, and eleven tables gave some other formula, i.e. 39·3 per cent.[1]

Other investigators have endeavoured to apply Heincke's methods to the differentiation of herring races. Some, e.g. Matthews,[2] say the method is inapplicable to the herring samples they examined; others, e.g. Hoek, claim successful results. The establishment of morphological differences between various herring races, if, indeed, such differences exist, is a task to be undertaken by future investigators.

In a recent paper, Williamson[3] summarises the methods of investigation into the races of European herring. He discusses the characters on which emphasis should be laid in distinguishing different races of herring, insisting on the necessity of having a uniform list of characters for use by all investigators. Reference should be made to this paper, which gives one an idea of the difficulties of the problem of distinguishing herring races.

An interesting account of the results obtained by the study of the scales is contained in papers published by the Norwegian scientists, Hjort and Lea. It is claimed that the scales furnish the best means of determining the age of a fish like the herring. Seen under the microscope, a herring scale is divided by a transverse line into two entirely different parts. One part is very transparent and exhibits no special peculiarity, whereas the other and posterior part is striated, and has a number of concentric transparent semicircular zones, each bounded by a dark line. The investigations prove that the dark, narrow rings are formed in winter, and are consequently called winter-rings; whereas the broad transparent zones are summer growths. A zone and a ring constitute a year's growth, and consequently from their number the age of the fish can be determined.



Scale of Herring—29 cm. in length.

[1] For further criticism see Jenkins, "The difference between spring and autumn herring," Trans. Biol. Soc., Liverpool, Vol. XVII, 1903.

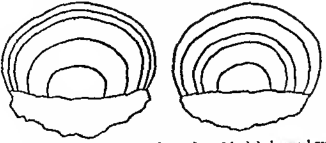
[2] "Report as to the Variety among the Herrings of the Scottish coast," *4th and 5th Ann. Rep. Scots. Fish. Bd.*, 1885 and 1886; 4th, p. 61–98 and 5th, p. 295–316.

[3] A short résumé of the researches into the European races of herrings and the method of investigation. Fisheries, Scotland, Sci. Invest, 1914, I (April, 1914).

It is further claimed that the scale gives a graphic representation of the growth, since the breadth of the summer zone affords an indication of whether the year's growth has been good or not As there are marked differences in the scales it becomes possible to distinguish separate races, or at any rate the separate shoals, and so trace the migrations The Norwegian herring fisheries fall into four main groups, for spring herring, which are adult spawning herring, caught from January to April off the west coast (between 62 and 63 N Lat), for large herring which are taken off the Romsdal coast in late autumn and winter, for fat herring which are unripe fish taken in autumn in Northern Norway, and finally small herring which are taken along the whole coast The shoals spawn only on the west coast, the young herring fry are carried northward along the coast by the prevailing currents The young unripe herring of Northern Norway are an early stage of the spring herring, the fat herring are a second and the large herring a third stage in the development of the same fish, so that all these different fishermen s terms for the herring are applied to different stages of one and the same race

If this view be correct, it is possible, by examining the scales from a large number of individuals of a season's catch in any particular locality, to determine from what year's shoal of the spring herring they originated In 1904 herring were exceptionally abundant, the "brood" of this year being very numerous In 1909 the fat herring season was twice as productive as any other year between 1901 and 1910, investigation of the scales showed that about 50 per cent of the August-caught fat herring were born in 1904 Similarly in 1910 and 1911 about three-quarters of the spring herring were traceable to the year 1904 The significance of these facts lies in the possibility opened out of tracing the movements of herring shoals

Hjort and Lea go even further than this They claim that, for some reason or other, the 1904 herring grew badly in their third year of life, and consequently the transparent space between the second and third winter rings is but feebly developed



Herring scales showing (left) normal growth, and (right) abnormal growth of Norwegian herring of 1904 in their third year

These herring of 1904 are so easily distinguished from those of other years that the term "marked" herring may legitimately be applied to them. At any rate, Hjort and Lea claim to be able to trace their movements through successive years. In 1907 and up to September, 1908, the marked herring were practically confined to northern Norwegian waters, only occasional specimens being met with elsewhere.

In 1908 some of them made their appearance in the large herring of the Romsdal district, and were taken there in the next two years. In 1910 they made their first appearance among the spring or spawning herring further south, off the west coast; in this year they were even found off the Faroes, the Skager Rack, the Cattegat and the southern part of the North Sea. If these results be substantiated by future investigators, it will lead one to believe that the herring performs wider migrations than had recently been supposed. It must not be forgotten that opinions are sharply divided as to the utility of the investigations into the rate of growth of herring and other fish by the scale-examination method.

Molander[1] has recently summarised the arguments in an elaborate monograph. He shows that the scales do not appear in the young herring until they are 30 mm. (about 2 in.) long. The period of active growth in autumn, spring and winter spawning herring varies and thus affects the scales. Molander concludes that while the scales increase together with the fish, the increase is not proportionate. During the first few years the fish grow more than the scales; while in later years the scales grow more than the fish.

[1] "Ur Svenska Hydrografisk-Biologiska Kommissionens Skrifter" (1917).

CHAPTER V

THE RISE OF THE HERRING FISHERIES

(Description of illustration, p 104)

James Riddell, Esq, Superintendent and Jno Kelway Invt, T Craskell delin Anthony Walker, Sculp

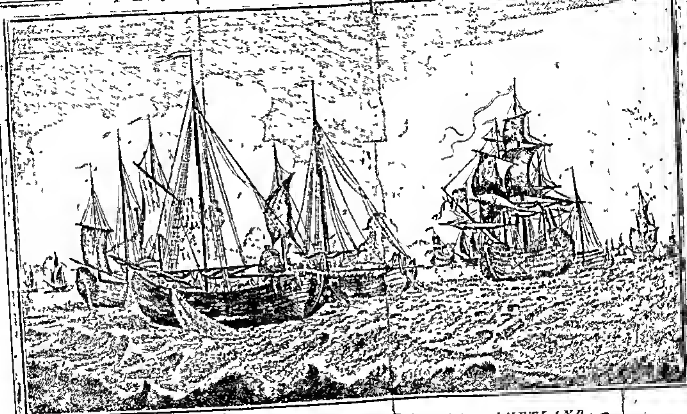
To His Royal Highness George Prince of Wales, Governor of the Society of the Free British Fishery

This view of the Busses on the Fishing Ground off the South Coast of Shetland from Sumburgh Head and Hang Cliff is most humbly described by His Royal Highness's most devoted and most obedient humble servant Tho Jefferys

1 A buss lying on his nets all night and the manner of heaving in the nets and leading them aft
2 The buss rope and which every net is carried too, with a buoy to each on the buss rope
3 The Seizing from the Net-rope to the Buss rope
4 A Grampus shewing that Herrings are near
5 A buss with all her nets except one, hauld in
6 A Dutch Buss, with all her nets in, going to make sail
7 The Superintendent's Ship, namd the Prince of Wales, belonging to the Society, of 330 tons and 20 guns
8 The English man-of war, Peggy, (Capt Bryen) of 150 tons and 8 guns firing at a French fishing vessel
9 The Jagers or Tenders waiting on ye Busses to carry the Herrings to market
10 A Dutch Commodore Dogger
11 A Dutch Fly Boat as an Hospital Ship
12 Sumburgh Head
13 Fair Isle
14 Entrance into Brassa Sound
15 Do Island
16 *Hang Cliff*

A View of the British Fishery
off the S.º Coast of Shetland.

For the London Magazine. Printed for R. Baldwin Jun.r at the Rose in Pater Noster Row.



The BRITISH deep water Herring FISHERY off BRASSA in SHETLAND.
Taken at Sea July 14 1750

N.B.—Most of the Busses, are under sail, for the N.E. of Shetland, in order to shoot their nets, (each whereof is 16 fathoms long) and are allowd a mile for that purpose, Every Buss (Burden near 80 tons, carrying about 17 men, and 50 nets) will frequently catch, from 160 to 200 barrels;—that is, near 150,000 herrings at one haul.

Published according to Act of Parliament Augt. 19th, 1752, by Tho; Jeffreys, at the Corner of St. Martin's Lane in the Strand, London.

TO give a detailed historical account of the development of the herring fisheries in British waters is beyond the scope of the present work. The pioneers of the modern herring fisheries in the North Sea were the Dutch,[1] and their salt herring trade was the result of the discovery of an improved means of curing and pickling herring by William Beukels of Biervelt.[2] The method depended on the effective gutting of the fish. This was about the middle of the fourteenth century, and the trade in this product developed rapidly. Already in the fifteenth century cured herring formed an important item in the diet of the English Army. At the Battle of the Herrings (1429), the equivalent of what is now the Army Service Corps, acting on the defensive, formed a laager of herring barrels, and successfully beat off an attack by the French Army.

In the sixteenth and seventeenth centuries, thanks to the fisheries, the Dutch became a great maritime and naval power, but it was not until late in the latter century that determined efforts were made by the British to wrest the supremacy in the North Sea herring fisheries from the Dutch. Although James I asserted the rights of the kings of England to "Dominium Maris," he did not push things to extremes, and it was left to Charles I to take the first serious steps against "the Hollanders and Hamburg tigers."

The steps taken both by Charles I and Charles II consisted mainly in the formation of Royal Fishery Companies.[3] One of the earliest

[1] "The History of the Dutch Sea Fisheries," by A. Beaujon. International Fisheries Exhibition Literature, London, 1883, Vol. IX, p. 299; and Fulton, "The Sovereignty of the Sea." Edinburgh and London, 1911.

[2] Neucrantz, "De Harengo de exercitatio medica, in qua principis piscium exquisitissima bonitas summaque gloria asserta et vindicata," Lubecæ, 1654, p. 74. "Primus quidem inter Belgas condiendi et in tonnis conservandi Harengi rationem excogitasse fertur Gulielmus Beukelius, alius Beukeldius, magni nominis piscator, qui in anno 1347 Biervlieti extremum vitae diem clausit; ob quem momento sum inventum posteritas etiam nunc reveretur viri memoriam. Carolus quintus, imperator, tanti hoc inventum fecit ut Bierylietum una cum sorore Maria, Hungariae reginae adpellens sepulchrum Bucheldii adient veneratusque sit, haud sine memoria ejus, tantique ad omnem posteritatem ab eo profecti beneficii celebratione ut testantur, Joh Pontanus, etc."

[3] *The Royal Fishery Companies of the Seventeenth Century*, by J. R. Elder, Glasgow. Maclehose and Sons, 1912.

and certainly one of the most interesting accounts of the herring fisheries in English is that by Simon Smith, who was agent for the Royal Fishery [1]

At this time (1630–40) a typical herring buss would be 75 ft long overall, with a length of keel of 45 ft The fore stem must fall in length forwards 23 ft, and the stern post falls backward 7 ft The keel would be 18 in deep at its fore part, 12 in deep at its after part and 14 in broad The depth from the keel to the uppermost deck would be 10 ft, 4 ft from the lower deck to the keel, wherein are ten double rooms, besides the net rooms for stowage

The cost of building such a herring-buss in the reign of Charles I was £500 The cost of her fleet of fifty six nets would be £237, stores, wages and victualling for a two months' voyage, £165 Depreciation of the nets would be £70 and of the vessel £20 for the voyage, total charges £255 The accommodation was for 412 barrels, and the estimate of profits was based on the assumption that 400 barrels of herring would be caught and sold at one pound per barrel, the gain being £145 It is to be feared that the hopes entertained were far too sanguine, in fact, the history of the Fishery Companies shows this

The herring fleet assembled off the coast of Shetland by the beginning of June, "when the herrings do rise about Crane Head which is the headland or outmost part of Bratio Sownde" (Brassa Sound) Here the herrings abide for fourteen days when the fishing was transferred to Farry Island (Fair Island), 7 leagues south of the Shetland for another three weeks After that to Buffin Ness (Buchan Ness), about 30 leagues to the southward of Farry Island, the fishing place called Buffin Deep, 20 leagues to the northward of the Firth (of Forth) where the herring remain for fourteen days, and fourteen days more on the fishing grounds "under Chivet hils and Chivet Chace" Thence to the Dogger hancke, where the fishery lasted a month or six weeks Early in September the fishing started off Yarmouth, where it lasted till mid November It is certainly remarkable how this drift net fishing for herring has persisted on the same grounds and at the same seasons to the present day

Several different kinds of herring are specified The "sea-sticks" are as they are packed at sea These are afterwards repacked on shore, seventeen harrels of the sea-sticks making twelve repacked

[1] The Herring Busse Trade expressed in sundry particulars both for the building of Busses making of deepe Sea Nets and other Appurtenances also the right curing of the Herring for Forreine Vent Together with sundry orders of the Netherlands for the better Governement of the Royall Fishing as by the following Treatise doth more at large appeare All which hath bin perused by the Parliament Committee and is appointed to be published for the general Direction of the whole Kingdome Written by Simon Smith Agent for the Royall Fishing 1641

barrels ; the herring are taken out, washed in their own pickle and laid orderly in a fresh barrel, which have no salt put to them, but are trodden down as close as may be, and so headed up.

Summer herring were taken from June to the 15th of July to be sold away in sea-sticks " to bee spent presently in regard of their fatness, and will not endure repacking, and so go one with another full and shotten." The repacked herrings are sorted, the full and sick and shotten packed separately.

There are also Crux herring, beginning the 14th September, that day being Exaltio Crucis. Corved herring are those taken off Yarmouth, and are used to make red herrings, " provided that they can bee carried on shore within two or three days after they be taken, otherwise they must be pickled."

The methods of fishing are also described by Smith. The nets were shot in the evening " and so drive all night, and in the morning they get them in again and gip (gut), salt and pack all the herrings before they set on the kettle."

A detailed account is also given of the disposal of the men and youths in the laying out of their nets and hauling them in again, as well as the employment of the men in their offices, when the nets are to be hauled up. When the fish are inboard, one man takes the herrings out of the well with the " ladnet " and fills the gippers' baskets. Nine gippers cut the herrings' throats and take out the guts, fling the full herring into one basket and the shotten into another.

One man takes the full baskets of gutted herring and carries them to the " rower backe, wherein is salt." A boy " rows " them up and down in the salt, while another takes the rowed herring in baskets to the packers. Four men pack the herrings into barrels, while another takes the full barrels from the packer. The barrels stand open for a day, so that the salt may be dissolved in the pickle ; they are then filled and headed up. Full particulars are also given of the employment of the fishermen and sailors in harbour and till they come to the fishing grounds, and also of their duties on the homeward voyage.

The best locality for a plantation for the fishing next receives attention, together with a list of the provisions for the buss. Amongst other items of outfit are specified : " Hempe brought in by the eastland merchants from the parts of Lieffeland and Prusia, pitch and tarre from the Balticke Seas and Norway. Barrels, boards and willow hoopes from Hambourgh and those parts. Deale-boards, masts and sparres from Norway and firewood. Lixboan [Lisbon], salt, and salt upon salt[1] made in England. Normandy

[1] John Collins in " Salt and Fishery, etc.," 1682, p. 13, describes Salt upon Salt or salt made by refining of foreign salt.

canvas for sayles, and Ipswich canvas Pease and oatmeale Butter and cheese Bacon in gammons Aqua vitae and vineger Gipping knives and chopsticks, adzes and other tooles Leather for the gippers Barke of ashen trees for tanning the nets Sea-coales for heating the copper for tanning Corke and rosen from Burdeaux Candles and other chandlery wares A good quantity of deepings or quarter nets always in readinesse, for to new the nets at the return of the busses And all the twine that can be gotten of the summer spinning, which is then best made both for spinning and drying "

The Royal Fishing Companies referred to received both financial support and certain other privileges from the Government In addition to the contributions of the Companies various devices were employed to raise money The right to hold lotteries was granted to the Council for the fishery, and the King (Charles II) made an appeal for collection in the churches

The first of these Companies was the "Association for the Fishing," established by Charles I in 1632 This Association under the active personal interest of the King (Charles I) made several attempts to embark in the herring-buss fishery A great drawback to their success was the activity of the Dutch and Dunkirk privateers Even when herrings were caught and cured they were rejected in the foreign markets, e g at Dantzic in 1637 and 1638 The outbreak of the Civil War deprived the Association of the King's interest and support, and it soon died a natural death

Other societies were established by Charles II

For various reasons none of these companies was successful Jealousy between the English and Scotch was one reason Mismanagement on shore, the difficulty of obtaining the services of qualified fishermen and fishcurers, the depredations of the privateers of Dunkirk and Ostend, and finally the competition, both legitimate and illegitimate, of the Dutch, proved too much for all the fishery companies [1] Moreover, the generally unsettled state of the kingdom rendered the active support of the monarch an uncertain quantity, so that the reigns of the Stuarts witnessed a series of unsuccessful attempts on the part of Great Britain to compete with her Dutch rivals in the fishing trade, it was reserved to the eighteenth century to see the British supreme in the North Sea The chief cause of the decline of the Dutch sea fisheries in this century was the frequent maritime wars in which the United Provinces were engaged The withdrawal of the Dutch competi-

[1] There are references to the Company of the Fisheries in Pepys Diary for 28th November 1662 and 10th March 7th and 9th July 3rd and 13th September 10th and 25th October 1st and 18th November and 3rd and 22nd December 1664

tion was, however, only one cause of the rise of the British herring fisheries, now the greatest in the world.

In 1750 an Act for the Encouragement of the British White Herring Fishery was passed, and the incorporation of the Society of the Free British Fishery followed.[1]

The Society of the Free British Fishery of 1750,[2] the last of its kind, originated at a meeting held at the King's Arms Tavern, late the Swan, in Exchange Alley, the 10th day of January, 1749, Mr. Alderman Jansen, Sheriff of London, in the Chair. A minute[3] of the meeting of the 2nd March, 1749, contains a list of 121 names of "gentlemen, merchants and others who propose to encourage the British White Herring and Cod Fisheries, in consequence of a Resolution of the House of Commons and of a Bill brought in there upon." The subscriptions ranged from £100 to £25,000, the latter sum being furnished by "Francis Grant, Esqr., for himself and the Chamber of the City of Edinburgh." The total amount forthcoming at this meeting was £214,900, the Lord Mayor subscribing £2000. At the next meeting, 9th April, 1750, at the Queen's Arms Tavern, St. Paul's Churchyard, nets for three busses were ordered to be ready before the 26th May; three busses to be built at the same date; "one or more messengers" to go to Holland to engage persons experienced in the "sorting, curing, gypping and barrelling of herring."

On the 17th May the record states, "sent for and examined three Danish skippers lately arrived from Holland as to several particulars relative to the fishery, and received satisfactory answers." Subsequently two Danish skippers and twelve Danish seamen were taken on as part of the crews of the two busses which were being built at Southampton. Later in the same month, "Launched the first buss from Whetstone and Grevilles Yard, Limehouse Bridge, and named her *Pelham*. The next buss to be launched on Friday."

Evidently the first two busses were built on the Thames, the other two at Southampton. The second buss referred to was launched "on the river" on the 25th May, and was named *Carteret*.

The minutes for the 31st May state, "Recommended to Mr. Janssen to write to Mr. Bosanquet about sending a present of the first herring to the King (George II) at Hanover." Each "buss" had a "tender," and they sailed for the Shetlands on the 3rd June,

[1] A number of fraudulent fishery companies were floated at the time of the South Sea Bubble (1720–1). Reference may be made to Anderson, *History of Commerce*, 1787, Vol. III, p. 105, 106 and 108.

[2] For fuller particulars see *An essay towards a Natural History of the Herring*, by J. S. Dodd, London, 1752, p. 154, *et seq*.

[3] I am indebted to Dr. Fulton for a transcript of the minutes of this Society.

a sloop of war, the *Spy*, accompanying them to afford protection from all " insults "

The instructions to Fulcher Greaves, master of the buss *Pelham*, were to take the orders of the Danish masters regarding everything pertaining to the fishing, one barrel of salt to three and a half barrels of herrings, and two bushels more if repacked, the early fish to be dispatched to Hamburgh and Bremen " If you can conveniently and without loss of time, you may sort the herrings that are caught, marking the barrels ' M ' for Maties or Maiden, ' F ' for Full and ' S ' for Spawn'd "

Danish fishing masters and seamen were employed because there was at this time a large Danish deep sea herring fishery from the Elbe-Holstein coast

The King was asked to be the Governor of the Society, but he declined, the Prince, however, accepted

On the 12th July there is a letter from the agent at Hamburgh saying that he had received twenty and a half barrels which were sold at £80 per last,[1] " but allowances made for the barrels not being full " Another letter (16th August) states, " received 164½ barrels which were sold at 122 rixdollars per last of 14 barrels for 12, by reason of their being loose packed "[2]

Precise instructions were given to the masters of the busses, they were warned to avoid disunion between the Danes and British part of their crews The evils of drink were pointed out A letter was sent (11th August, 1750) to the masters of two busses, exhorting them to restrain their passions and to keep good order, and " doe you direct perswade the most sedate and ingenious parts of your English crews, nay, bribe them to it by a gallon or two of Brandy, to learn the Dutchmen's secret in gypping, salting, packing and curing of herrings " This was after they had unsuccessfully tried to get a Dutch master

On the 11th September, 1750, there were sold by auction at the Royal Exchange Coffee House, where the meetings were now held, *two barrels, Maties, for £10 5s, and £10 11s, two of full herrings* for £9 and £10 12s, and fourteen half barrels from £5 10s to £7 14s, total for four barrels and fourteen half-barrels £130 4s

On the 27th September, at the same place, one barrel and six halves from the Shetlands made £75 11s, the single barrel bringing £18 17s 9d, and the halves from £8 16s to £10 6s On the 19th October, fifteen whole and nineteen half barrels brought in £160 13s

On the 25th October, 1750, the Charter of the Society was pre-

[1] The figure 8 is obscure in the original manuscript it certainly seems a large sum but it resembles 8 more than any other figure

[2] A rixdollar was about 1s 6d and a last of white herrings is 12 barrels of red herrings 20 cades or thousands (*Tomline Law Dictionary*)

sented to the Prince in person at Fishmongers Hall, " upon which His Royal Highness was presented with wine, herrings and sweetmeats, after tasting and commending the herrings, he drank success to the undertaking and was conducted back to his coach."

The other two busses of the Society were the *Bedford* and *Argyll*, they fished on the west coast of Scotland, after the manner of the Societies of the Stuarts, the *Bedford* catching 103 and the *Argyll* 130 barrels off " Stronway."

The first meeting of the General Court of the Society after the receipt of the Charter, was on 7th November, 1750. The Committee which had managed the fishing submitted a report which stated that the busses were built on the Thames, a vessel being obtained from Holland as a model. The Committee congratulates itself on its great success, two busses having fished at Shetland and Yarmouth and two on the north-west of Scotland, both being very successful. It was resolved that a book for the taking in of voluntary subscriptions for the sum of £500,000 be opened. Advertisements were issued for proposals for building more busses.

On the 21st February, 1751, there is a great deal about building busses, the contract price being from £6 10s. to £7 per ton. In 1753, thirty-eight busses went to the Shetlands, but by 1755 the Company was in difficulties. On the 19th April the Council resolved on a plan of " letting out the Society's Busses " (over and above the number of twenty-five, which they themselves do employ) as the " foundation for offering an advertisement to the public," they will ask " no more than £300 security " for each buss, the Society to safeguard itself by insurance. The calculation was based on the supposition that each buss catches 400 barrels of herrings in both fisheries (Scotland and Yarmouth), and that the Society pays the contractor 21s. per barrel for the same, to be delivered to their jagers in Shetland or Yarmouth Roads :—

400 empty barrels will cost . . .	£63	6	8
400 bushels of salt at 13/0½ . . .	22	10	0
Wear and tear of the buss annually .	50	0	0
Jagers, hire for each buss . . .	25	0	0
Wear and tear of nets, annually . .	100	0	0
Annual repair of the buss . . .	25	0	0
Wages and victualling each buss . .	210	0	0
Total	495	16	8

The report continues, 400 barrels of herring at 21s. will make £500 [*sic*], which with savings from the above calculation should be sufficient to make them engage, and should the buss catch more than 400 barrels, the overplus would be clear profit. " And the

profit to the Society will stand as under on each buss—tonnage bounty, 30s per ton on 78½ tons is £117 15s, which on £1200, the full value of a buss and nets is £9 15s, 11 per cent, out of which deduct 2 per cent for charges of management and 2 per cent for insurance, equal to 4 per cent The bounty of 2s 8d per barrel *will pay the cooperage and charges* "

It is plain that the Company is now in a bad way

Later the " warm impressing of seamen " was a great obstacle to the letting out of busses It was found " fruitless " to let out any this season, " occasioned chiefly by the high wages " Almost all the business was now left in the hands of Captain Yoakley, who was in charge of the busses There were now many defaulters on a call for 5 per cent In June, 1755, there were 103 members of the Society, many of them women, the amount of stock held varying from £3000 to £7 14s. 11d On 3rd July there is an entry " proposals for the provisioning of twenty five busses for Yarmouth fishing to be obtained " The jagers were to provide themselves from Germany The minutes become more and more fragmentary, and little information is given In October, 1755, it was resolved that at the close of the Yarmouth fishing all the busses be brought up the Thames, " as they had suffered damage from the worms," and that all the Orkneymen be discharged at London The crews were now chiefly from the Orkneys, engaged under contract

On the 30th October a sum of £2117 0s 5d was received from the Commissioners of Customs, presumably for bounties under the Act of 1750, and it was resolved that it be divided as follows £1930 4s among the proprietors of the Society at the rate of £1 9s. 7d on the sums both respectively paid in, and to the Chamber of Whitehaven, £91 2s 8d, to that of Montrose, £55 18s 5d, and to that of Edinburgh, £39 15s It was also suggested that the busses should be offered to the Admiralty " for a consideration in the present conjuncture of affairs "

There was correspondence with the Admiralty in March, 1756, regarding " protection " (from the press gang) for 230 men employed at Southwold, in refitting the busses and making the nets for the approaching fishing, and for sixty coopers and twenty shipwrights The Admiralty asked the reason so many were required, since last year only eighty-two were asked for It then appears that in 1755 they had only fitted out twenty-five busses and five jagers, and in 1756 there were thirty busses and six jagers By the Act of 1750 the crew of each buss was to consist of seventeen men, which with eight men for each jager, gave a total of 567 There were now remonstrances to Yoakley for spending so much money, and a complaint that it was because he was not at Shetland last

year in time (22nd June) that the Society lost so much money, and the jagers were not in time to go with the fish. At this time the men on the busses were paid £3 10s. a month, cutlasses and muskets provided. Yoakley was told that the ransom for a buss. if taken by the enemy, was not to exceed £200.[1] All the fish was to go to Hamburg and Bremen in equal quantities. The agent at Hamburg complains that 167 barrels of 417 brought by jager were bad.

He is thanked for not selling them, as it would " compromise the reputation of the Society." The busses were laid up at Sole (or Sale) for the winter, and the salt and barrels stored there. The troubles of the Society accumulated; there was great difficulty in getting St. Ubes salt, but 50 tons were eventually obtained at 40s. per ton. At this period the French privateers swarmed off Yarmouth, so that the Yarmouth fishery proved a failure. The herrings were sent to Hamburg in neutral bottoms on the best terms obtainable. The Society now contemplated the sale of the busses, and Yoakley was informed that the price was £400 without furniture and £550 with. A jager with its cargo of herrings was captured by the enemy. The Secretary of the Society, John Lockman, was obviously incompetent, and the Society further declined. Finally, on the 17th March, 1772, all the busses and other effects belonging to the Free British Fishery were sold at the Old Swan, Southwold, for £6391 12s. 2½d. " Also their extensive buildings on the common for the sum of £310."

As Anderson says, " It is, indeed, extremely difficult to beat another nation out of a trade they have so long prospered in, even with the above great encouragement from the public, and more especially so frugal a people as the Dutch, who can content themselves with smaller gains than other nations, and carry on the fishery every one on his own private bottom."[2]

Contemporary documents of the reign of George II show that, in spite of the failure of such schemes under the Stuarts, " Societies " for the carrying on of the herring fisheries were still in favour.[3] It is, however, very doubtful, in spite of the ingenious arguments set forth by some of these pamphleteers, whether a joint-stock

[1] See evidence of Mr. Nathaniel Saunders, " Third Report on the State of British Fisheries," 1785, p. 22. " In the late war, there being a number of vessels fishing for cod on the Dogger Bank, a French privateer fell in with them, and captured 13 sail, which were ransomed, upon an average, for 150 guineas each." These Harwich cod boats, of 45 to 55 tons, were smaller than the herring busses.

[2] An historical and chronological deduction of the *Origin of Commerce*, Vol. III, p. 277.

[3] Considerations upon the White Herring and Cod Fisheries; in which the design of carrying on and improving them, in the manner proposed by a Society trading with a Joint Stock, is fully explained, and freed from all objections. London, 1749 (Admiral Edward Vernon ?).

company unassisted by bounties would have had any success in the herring fisheries

As a matter of fact, the only Society actually started was, as we have seen, even with the assistance of the bounties, a failure

A connected account of the history of the herring fisheries of the British Isles from the time of the Stuarts to 1830, the year in which the bounty system was discontinued, has yet to be written Portions of this period have been dealt with, and criticism directed to the part played by the bounty system in the development of these fisheries, subsequent to the failure of the Fishery Companies If, as Adam Smith stated, " it has been too common for vessels to fit out for the sole purpose of catching, not the fish, but the bounty," it is difficult to explain why the fishery did not collapse when the bounties were withdrawn

The first Act which provided a bounty for catching fish was one entitled, " An Act for recovering the credit of the British Fishery in foreign parts " (5 Geo I, c 18, 1718) [1] Provision was made for the payment of a bounty for several kinds of fish, for every barrel of white herrings of 32 gallons exported into parts beyond the seas the bounty was 2s 8d, for every barrel of full red herring 1s 9d, for every barrel of clean shotten red herring 1s It was also lawful, on exportation, to mark any cask, barrel or other vessel wherein such herrings, etc, shall be exported, to the intent that it may be known that such herring, etc, have been exported and allowance obtained on exportation of the same No allowance was to be paid for unmerchantable fish, and officers might enter into any warehouses to view the fish curing

In the Act for the encouragement of the British White Herring Fishery (23 Geo II, c 24, 1750), the conditions preceding the payment of the bounty are set forth in some detail A sum of 30s per ton bounty was to be paid out of the Customs, for decked vessels from 20 to 80 tons burthen built for the herring fisheries Every such vessel had to be built in, and to proceed to the fishery from, *some port in Great Britain Vessels were required to proceed either* to Brassey's Sound in Shetland by the 11th June, or else to Campbeltown in Argyllshire by the 1st September In the first case fishing had to be followed to the 1st October, in the latter case to the 31st December, " unless they shall have sooner compleated their loading of fish " The master was required to keep a journal of their proceedings, a requirement which would be useful even at the present day To prevent disputes, minute regulations were prescribed to determine whether a vessel be properly qualified and duly fitted

[1] Bounties were given on the exportation of herrings by an Act of Queen Anne 1705

out for the herring fishery. Each vessel shall have on board 12 Winchester bushels of salt for every last of fish which such vessel is capable of holding, which salt shall be barrelled up in new barrels. Each vessel was required to carry two fleets of tanned nets proper for the herring fishery, that is for every buss of 70 tons burthen one fleet of fifty nets, each net to be 30 yd. full on the rope, and 7 fathoms deep; and so in proportion for vessels of other tonnage. The crew of a vessel of 20 tons were to be not less than six men, and an additional man was prescribed for every 5 tons above 20.

On the return of the vessel from the fishery, an officer of the Customs was to go on board to certify the tonnage, the names of the master and other persons on board, etc. The master had to take oath that his vessel was at one of the places above mentioned. The certificate, schedule, licence and oath, together with an account of the fish caught, were then transmitted to the Commissioners from that part of Great Britain whence the vessel departed, who then caused payment to be made by the Receiver-General of Customs of the bounty of 30s. per ton. The bounty was limited to an annual payment for fourteen years from the commencement of the Act. Three years later the Act was amended (by 26 Geo. II, c. 9), so as to regulate the herring fishery by the calendar now in use. Other modifications were introduced, the chief of which was that vessels which shall rendezvous at Kirkwall in the Orkney Islands by the 12th September (instead of Campbeltown), shall be entitled to the bounties, if otherwise qualified.

Several other Acts were passed having the object of improving the sea fisheries, among which may be noticed 29 Geo. II, c. 23 (1756), by which a bounty of 1s. was paid for every barrel of white herring of 32 gallons entered for home consumption in Scotland, and 3s. 4d. per barrel for white herring brought into England from Scotland. Fish cured in Scotland might be brought into England for re-exportation, and the bounty was allowed on the exportation of such fish to foreign parts in the terms of, and on compliance with, 5 Geo. I, c. 18 (see above).

In 1757 the bounty for the herring busses was raised from 30s. to 50s. per ton, and this continued until 1771, when another Act reduced the bounty from 50s. to 30s. per ton.

The Act of 1771 remained in force until 1787, when it was replaced by still another Act which provided 20s. per ton bounty for the busses, with an additional bounty of 4s. per barrel of herring taken, but limited to a proportion of the tonnage, so that no vessel could claim more than 30s. per ton, except when the quantity of fish taken was greater than three barrels per ton, in which case a bounty of 1s. per barrel was allowed on the surplus quantity.

It will be understood from the provisions of the Act of 1750, quoted above, that these bounties were only claimable by vessels of over 20 tons burthen, that is vessels which were decked and capable of keeping the sea Since there was already in Scotland a fishery for herring, carried on close inshore and in sheltered lochs by open or half decked boats of less than 20 ton burthen, and which vessels were not in receipt of any bounty, it follows that there was much jealousy and opposition on the part of the boat fishermen to the buss fishery The Act of 1787 first recognised the claim of the boat fishermen to a share of the bounty, and they were now allowed to claim a bounty of 1s per barrel, nine years later increased to 2s per barrel

This boat fishery deserves more than passing reference Apparently it was more developed on the west coast of Scotland and in the Hebrides than elsewhere There is evidence that French and Spaniards trafficked for fish with the Hebrides from very early times The Hebridean fishery was the subject of regulation in the reign of James III, each boat paying a certain quantity of fish to the Crown, which formed a part of the hereditary revenue There was also an inshore fishery in the Clyde and Loch Fyne, chiefly carried on by the inhabitants of Glasgow, Dumbarton and Ayrshire [1] In the reign of Charles II, when the Royal Company, of which the King was a partner, took up the herring fisheries, they built a large house at Greenock When the Company dissolved in 1684 their buildings at Greenock were purchased at public sale by the magistrates and town council of Glasgow, who prosecuted the Clyde fisheries with perseverance and success This fishery was carried on in little boats, each with a crew of four men and provided with twenty four nets, every net being 6 fathoms long and $1\frac{1}{2}$ in breadth Of these boats 900 were frequently employed, the fishing lasting from 25th July to Christmas Some of the herrings were sold locally, some converted into reds but the greater proportion was exported In 1674 20 400 barrels were exported to Rochelle This fishery decayed after the union, it did not benefit by the earlier Bounty Acts, and it was the Act of 1787 which first recognised the claim of these men to the bounty In 1797 there were in Scotland 797 such boats not on the tonnage bounty, manned by 2618 men [2]

The boat fishery was also carried on off the east coast of Scotland, on the coast of Caithness and in the Firth of Forth

[1] A view of the British Empire more especially Scotland with some proposals for the improvement of that country the extension of its fisheries and the relief of the people by John Knox Two Vols third edition greatly enlarged London 1785

[2] Appendix VI to 2nd Report on State of British Herring Fisheries 1798 pp 280–281

Statistical evidence of the extent of this fishery will be found in Appendices (VI and VII) to the Second Report on the State of the British Herring Fisheries of 1798.

In the Firth of Forth the old method of fishing was by means of nets set between two anchors at night, and fished the following morning. This fishery seldom lasted above a week.

Subsequently the fishermen sought for the herring in deeper water, further from the coast, by means of drift nets. A boat engaged in this fishery had nine nets each, 45 yd. long and 10 yd. deep. In 1784 the herring caught at Eymouth, Dunbar, and on the Fife coast amounted to about 10,000 barrels.[1]

The working of the various Acts designed to improve the herring fisheries was closely watched by Parliament, and Committees were appointed from time to time to report on the state of the sea fisheries, and the best means for securing their development.[2]

Apart from two reports of Committees on the state of the pilchard fisheries (1785 and 1786), and which are only of local interest; the first reports which throw light on the bounty system, the salt duties and other matters affecting the sea fisheries, were those of the Committees of 1785[3] and 1786. When the first of these Committees was appointed the Act of 1750 had been in force for thirty-five years, and it was reasonable to expect definite information as to the success of the bounty system or the contrary. As a matter of fact, it is found that the evidence available was of a conflicting nature, and in this respect the eighteenth century resembles the twentieth.

The earlier statistics of the busses fitted out under the bounty system are not available. The Society of the Free British Fishery, which was established under the Act of 1750, is supposed to have fitted out from thirty to forty busses, but the custom-house books for 1753 prove that the whole herring fleet consisted of eight vessels only. In spite of the increase of the bounty from 30s. to 50s. per ton in 1757 the Society gradually died out, and it was left to the enterprise of the towns on the Clyde to carry on the herring buss fishery. From 1760 to 1766 inclusive, the number of busses was respectively 13, 17, 49, 87, 119, 157 and 261. In the last year the revenue was found insufficient to pay all the demands on it, and

[1] For further details of this fishery, see, in addition to the Report mentioned above, Robert Fall, " To the Honourable the Committee of the House of Commons appointed to enquire into the state of the British Fisheries, the following observations on their Report are most respectfully subscribed by their most obedient humble servant," p. 103. Dunbar (n.d., but *circa* 1786).

[2] For further details see, " Tenth Volume of Reports of the House of Commons," 1785–1801, large folio, pp. 1–390.

[3] The Committee of 1785 issued three reports, the first two being very brief and the third voluminous.

the payment of the bounties was suspended This suspension lasted until 1770, during this period the number of busses declined to 263, 202, 85 and 19 The adventurers now petitioned Government to reduce the bounty to 30s per ton, but to pay it regularly This was done, with the result that the number of busses increased as follows in the years 1771 to 1783 29 169 190, 249 281, 294 240, 220, 206, 181, 136, 147 and 153 The decrease during the last seven years is attributed to the Dutch war, which cut off the supply of materials from the Baltic, to the American war which enhanced the price of materials for the fisheries, to the terror of privateers which swarmed on the coast, to the pressing of men for the Navy, and partly to the failure of herrings on the north-west coast of Scotland, and finally to the order of the Commissioners of the Customs at Edinburgh prohibiting the busses from fishing off the Irish coast under penalty of forfeiting the bounty

The Committee of 1785 had no hesitation in reporting that the system of the salt laws is one of the principal reasons why the fisheries of Great Britain have never been carried to the height of prosperity and advantage of which they were capable

Adam Smith, by a deliberate manipulation of statistics to serve his argument, endeavoured to throw discredit on the bounty system He stated that in the year 1759 each barrel of merchantable herring produced by the buss fishery cost the Government in bounties alone £159 7s 6d A reference to the official statistics shows that Smith selected the year when both the number of busses and the produce of the fisheries were at their lowest ebb Smith forgets or ignores the fact that the failure or success of the bounty system does not depend on the amount of bounty paid per barrel of herring in a single year arbitrarily selected, and that year the least effective from a fishery standpoint It must not be forgotten that the busses only reckoned one voyage per annum for the purpose of establishing a claim to the bounty, and this voyage was not to be of more than three months' duration Many busses made a second or even third voyage Smith points out in another argument that the busses in the eleven years, 1771–1781, caught only 378 347 barrels, but it is more than probable that the actual catch was at least double that amount, the yield of second and subsequent voyages not counting towards the claim for bounty

The Committee of 1785, in their third report, say they cannot represent the buss fishery as being in a flourishing state, for in the year 1782 there appear to have been but 135 busses, navigated by about 2000 fishers, fitted out from all the ports of North Britain

"Your Committee, however, are sensible, this bounty has not been entirely misapplied, many hands have been trained to the

sea who would, in all probability, not otherwise have been so trained. The places from whence this fishery is carried on have increased in wealth and numbers, and have not been backward, during the last war, in furnishing their quotas to the manning of the Navy. Your Committee are not prepared to recommend to this House the discontinuing immediately the bounty on the buss fishery; for, as many people have embarked their property in this trade, it may be advisable to continue the bounty for some time longer, till the effect of other measures shall be known."

Four reports on the state of the British Fisheries were made by a Committee of the House in 1786. All these reports were brief, and to some extent concerned with other fisheries than those for herring. Recommendations were, however, made to the effect that part of the bounties paid to the busses should be tonnage, and part for the herring actually caught. The boat fisheries for herring were also recommended for participation in the bounty system. Both these suggestions were incorporated in the Act of Parliament passed in the following year.

The next Parliamentary Committee was that of 1798–1800, appointed to inquire into the state of the British Herring Fishery, the most effectual means of its extension and improvement, and on the means of procuring a plentiful supply of fish during the high price of provisions. This Committee made three reports in 1798, one in 1799 and two in 1800.

By this time the herring buss fishery had become firmly established, as the following statistics, presented to the Committee, show.

Annual Average Statistics of the Herring Buss Fishery, 1762–1796, Scotland

	Vessels.	Tons.	Men and boys.	Barrels.	Bounty.
Period I—Nine years, Bounty 50/- per ton .	139	6,396	1,486	16,644	£15,992
Period II.—Sixteen years Bounty, 30/- per ton .	190	9,084	2,100	29,089	£13,639
Period III.—Ten years. Bounty 20/- per ton and 4/- and 1/- per barrel .	294	14,439	3,366	53,606	£20,601

The first report of 1798 merely proposes an extension of the existing legislation until 1st March, 1799. The second report contains the evidence and papers arranged under nine headings, viz. the buss fishery, the boat fishery, the Liverpool and Yarmouth fisheries, miscellaneous relating to British fisheries in general, the

fisheries of the Isle of Man and Ireland, Foreign fisheries, the Newfoundland fishery, fish soap, and the various accounts referred to in the different parts of the evidence The third report contained the resolutions of the Committee, the most important of which recommended a gradual reduction of the tonnage bounties to 10s a ton for two years, ending the 5th April, 1801, and to 5s per ton for three years, ending the 5th April, 1804

As might have been expected, the proposal to reduce and then abolish the tonnage bounty in the herring buss fishery caused consternation to the adventurers in the herring fishery, and we find representations regarding this in the next report of the Committee (19th March, 1799) There was a memorial for the adventurers in the White Herring Fishery from the ports of Campbeltown and Rothesay. "It is an easy matter to raise a clamour against the best and most useful systems, and it may be considered by some as a very popular subject to rail against bounties, but to the buss fishery of the Hebrides it does not, however, justly apply—that fishery, and the bounties connected with it, have been the means of establishing villages, extending towns, and creating fleets and seamen where there were none before, and have enabled our merchants to export to the West Indies annually about 40,000 barrels of herrings, exclusive of the home consumption, for which sugar and rum, paying high duties, are brought back in return"

Other memorials were presented by the adventurers in the Forth herring fishery and the fishery of Greenock The latter contains what is probably the best statement of the case for the continuation of the tonnage bounty The chief witness who advocated the abolition of the bounty system on tonnage was Mr. Irving, Inspector-General of the Imports and Exports of Great Britain, and this emphasises the contention of the adventurers of Greenock that the opinions and conclusions adverse to the buss fishery proceed from gentlemen having no actual knowledge of the fisheries These conclusions were rebutted The great argument in favour of the tonnage bounty is that owing to the great uncertainty attending the fishery this bounty was a sort of insurance against loss in bad seasons, to pay a bounty on the herring caught was merely to increase the takings in a good season

The arguments of the adventurers had no effect on the Committee, who in their report of 1799 declined to alter the recommendations as to tonnage bounty made in their third report in 1798 In certain other directions, e g in the quantity of herrings necessary to qualify for the limited bounty, the Committee gave way and modified their recommendations

The first report of 1800 recommends that the fishery laws, lately

expired or now in being, be revived and continued to the next session of Parliament.

The second report, which in addition to being concerned with the herring fisheries, also considers the most effectual means of supplying London with fish, contains much interesting information as to the general position of the British sea fisheries of the period.

Incidentally, the comments of the Committee on the salt duties are worth notice. They could not forbear to state strongly to the House their sense of the inconveniences under which the fisheries labour owing to the salt laws. The most considerable salesmen in London make a constant practice of paying the duty on salt used in the fishery, as being on the whole less burdensome than a compliance with the regulations for the use of duty-free salt. The weight of the duty was such that in general the fishermen chose rather to throw the fish overboard than to cure it, only taking to the market such fish as could be landed fresh. A substantial part of the supply intended for London had hitherto been destroyed in this manner. The Committee recommend a commutation of the salt duties as being preferable to any possible system of bounties. The Committee refer in terms of eulogy to some of the evidence laid before them, and in particular to an account of the herring fishery in the Firth of Forth by Mr. John Girvin of Leith, " a paper drawn up with great diligence and containing much useful information "; and a report of Mr. James Strachan, Land Waiter of the Customs at Burntisland, " which contains a much more minute and complete account of the whole process of the fishery, and mode of curing herrings in its various branches, as practised in the Forth, than has yet been laid before the House."

According to the Inspector-General of Imports and Exports there is an inverse proportion between the bounties and the industry of the fishermen; the less the tonnage bounty, the more their exertion and industry. To illustrate this the table above (p. 119) was prepared, the period of thirty-five years being divided into three periods; of 9, 16 and 10 years, according to the tonnage bounty being either 50s., 30s. or 20s. per ton. If, however, this period be divided into five equal septennial periods a different result is attained :—

THE SCOTTISH TONNAGE BOUNTY SYSTEM, 1762–1796

Years.	Tons employed.	Herring caught (barrels).	Barrels to the ton.
1762–68	52,740	129,629	$2\frac{1}{2}$
1769–75	46,051	197,362	$4\frac{1}{3}$
1776–82	69,692	205,849	3
1783–89	77,654	205,300	$2\frac{1}{2}$
1790–96	101,171	$413,505\frac{1}{2}$	4

That more adventurers embarked in the business in the later years, when the bounties were regularly paid, cannot be denied, but it is incorrect to say that during the first fourteen years less barrels were caught in proportion to the tonnage than in the last period of similar duration It is equally incorrect to say that the fishermen " seemed only to go out and fish for the bounty instead of herrings "

At this time the cost of building and fitting out a buss of 60 tons for the herring fishery would be about £957, and the tonnage bounty at 30s per ton on a vessel that size would be £90 Adam Smith must have known very little about fishing for herring if he thought a return of this kind would be sufficient of itself to induce people to invest their capital in it The expense of fitting out the vessel in subsequent years would be £313, so that even after the first year the tonnage bounty alone would be no inducement to persevere in the fisheries In fact, the establishment of a successful herring fishery was an extremely difficult matter, as the " Society of the Free British Fishery " discovered Established by the Act of 1750 with a paid up capital of over £100,000, with numerous privileges and immunities, the Society, nevertheless, was dissolved in 1772 with a loss of 92½ per cent of the original capital

Finally the Committee in their second report of 1800 seem to be very doubtful about making any definite recommendations They recommend a further delay in the adoption of a definitive and permanent system of regulation for the herring fisheries They urge that since an important measure of legislative union with the Kingdom of Ireland was under consideration, it became their duty to consider what effect " that great, and they trust most beneficial, change " was likely to have on the herring fishery At this time, large bounties were given by the Legislature on the herring fishery in Ireland (by the Acts of the Irish Parliament),[1] and the Committee were of opinion that the whole question of the improvement of the herring fisheries would early come up for consideration by the legislature of the United Kingdoms of Great Britain and Ireland

By a Committee of the House of Commons, in the year 1801,[2] the subject of the herring fisheries was again taken into consideration This Committee, considering the various difficulties and embarrassments which arose from the restrictions and regulations necessary for protecting the revenue arising from excise duties on salt, recommended that measures should be taken to abolish those duties

[1] An account of the bounty system in Ireland is given in Vol X Reports of the House of Commons 1785–1801 Report of 1798 p 264

[2] I have not been able to consult the Report of this Committee but see Fraser *A review of the domestic fisheries of Great Britain and Ireland* Edinburgh 1818 p 90

altogether, and to adopt means of raising an equal revenue in some other manner, which would leave the restriction of the fisheries at freedom from all those embarrassing accounts on so perishable an article as salt necessarily must be, when made use of in the most careful manner.

The renewal of the war, and the pressure of affairs, not allowing this recommendation to be complied with, and even rendering it necessary for the Government greatly to increase the duties on salt, the improvement of the herring fisheries was deferred for a period of seven years.

In spite of the animadversions of Adam Smith (the *Wealth of Nations* was published in 1776), the Government persisted in their efforts to establish a British herring fishery, and in 1808 " an Act for the further encouragement and better regulation of the British White Herring Fishery " was passed. It is to be feared that students of the rise of the British sea fisheries have been content merely to copy the opinions and ideas of Smith ;[1] but however unsound the bounty system may be from the standpoint of political economy, there can be no reasonable doubt that it was efficacious to a considerable degree in developing the British herring fisheries. In any case, the Act of 1808 deserves more than passing attention. The preamble sets forth succinctly the objects of the Act. " Whereas the improvement of the British white herring fishery is an object of most essential importance to the wealth and commercial prosperity, as well as to the naval strength of this kingdom," and then follow the enactments.

A bounty of £3 per ton was to be paid to the owner of any whole-decked buss or vessel of not less than 60 tons burthen, being British built, owned in Great Britain, manned, navigated and registered according to law, which shall be fitted out for, and actually employed in, the deep sea British white herring fishery. The maximum tonnage for which the bounty was payable on any one vessel was 100 tons. To obtain the bounty the manner of fishing in the deep sea was prescribed ; the nets were to be attached to the vessel while they were set and to be shot directly therefrom, and not with the intervention of a small boat. A bounty of 2s. per barrel was to be paid on white herrings taken in the British fishery, cured and packed according to the provisions of the Act. A Board of seven of the Trustees for Manufactures and Fisheries in Scotland were constituted Commissioners for the Herring Fishery. These Commissioners had to make an annual report to the Board of Trustees for

[1] See Spencer Walpole, *The British Fish Trade.* International Fisheries Exhibition Literature, London, 1883 ; and C.E. Fryer, *The Relations of the State with Fishermen and Fisheries, ibid.*, Vol. IX, p. 139.

Fisheries and Manufactures in Scotland and to Parliament The Admiralty were to appoint an officer of the Navy to be Superintendent of the deep sea British White Herring Fishery Officers of the fishery were appointed by the Treasury, and these officers " shall have exercised the trade of a cooper, and been employed in the curing and packing of herrings, and shall be skilful therein " In view of the modern controversy as to the mesh of the nets used in trawling for herring it is interesting to recall that the Act of 1808 forbade the use " in any river or loch or at sea, in or on the coast of Great Britain, of any herring net or any traul[1] net drag net or other sea net for the taking of herrings, which hath a mesh of less than 1 in from knot to knot, or any false or double bottom cod or pouch, or shall put any net, though of legal size, behind the others to destroy the small fish " There are elaborate provisions, as in previous Acts, for the fitting out of the busses with barrels of salt, with nets and an adequate crew, though now the full number of men are not required to be on board until arrival at the rendezvous Regulations are prescribed for the voyage to be made by the busses to obtain the tonnage bounty, and for the fitting and clearing out of busses at the port of outfit The Commissioners were also allowed to pay premiums or bounties, not to exceed £3000 per annum, for fishing herrings in boats exceeding 15 tons in Scotland

The reports of the Commissioners of the British Fisheries, Scotland for the period 1810–29 should be consulted for the details of the development of the Scottish herring fisheries under the stimulus of the Act of 1808 The report for the last year in which the bounties were paid (1829) summarises the effects which may legitimately be ascribed to the bounty system

" At the commencement of this establishment (i e of the Commissioners) there was scarcely a barrel to be found of 32 gallons, little attention was paid to the strength, breadth or thickness of the staves, to the number of the hoops, or the manner in which they were placed in the barrels, or the tightness of the cask at head and bottom, so that the pickle, without which herrings cannot be properly cured, cannot be retained, the herrings were generally cured ungutted, and often in bulk, without any attempt being made to extract the blood or entrails, and when the operation of gutting was performed, it was often so long delayed, and from being done with the finger and thumb so imperfectly executed, as to be of little use, the herrings were often left exposed to the weather on the bare ground, until it was found convenient to put them into casks, no fixed quantity of fish was required to be in the barrels, which were often in a great measure filled with salt instead of

[1] Really a seine net see p 51 footnote

herrings; the fish were in many cases thrown promiscuously into the barrels, without attention being paid to the regular packing of them; there was no regulation as to the size of the meshes of the nets, and, indeed, the use of small-meshed nets may be said to have been general, so that while the small fish were taken, the large ones escaped; the nets were never shaken at sea, by which the quality of the fish was much injured; and the boats, with few exceptions, were small in size, ill-provided with fishing materials, seldom cleaned or furnished with flooring boards or pumps, and the fishermen rarely ventured in them above two or three miles from the shore."

After only nineteen years of the bounty system, as set forth in the Act of 1808, the Scottish herring fisheries were worked on the following lines:—

"The barrels are uniformly of the full legal size, and made in a most substantial and workmanlike manner, the staves ½ in. thick throughout, of made work, the number of the hoops and the mode of fastening them fixed by regulations, and the tightness of the cask secured by the insertion of flags at the seams of the head and bottom ends. The herrings, as soon as they are brought on shore, are deposited in gutting-boxes, covered with shades, to protect them from the sun and the injuries of the weather, are seldom cured ungutted or in bulk, except when intended to be made into red herrings, and such of them as are intended for bounty are gutted with a knife, and regularly packed into barrels with a small portion of salt strewn between each layer, within twenty-four hours after they are caught, and those intended for exportation, cured in such a manner as to suit the market for which they are destined. The minimum weight of fish in each barrel is fixed by law, the barrels filled with pickle and every means taken to retain it, and as a security to the public, and a check on fraud and negligence, there is marked on each barrel the day on which the fish were cured, the curer's name and place of residence, and the name of the officer of the fishery by whom they were branded for bounty. The nets in general use measure 1 in. in the mesh, so that the fry is preserved, while full-sized fish only are taken. That the fishermen shake their nets at sea whenever the weather will admit of it. The small boats have been replaced by others of a superior description, averaging from 15 to 20 tons, each well furnished with oars, sails, anchors, nets, buoys, pumps and flooring boards, are washed out from time to time to keep them sweet and clean, and the men boldly proceed in them to sea till out of sight of land; and that while sixty or eighty crans of fish in the season were formerly reckoned a fair fishing per boat, the boats on the east coast, where

the fishing is principally carried on, frequently catch from 300 to 400 crans, and the fishermen are not satisfied unless the average is 200 crans per boat" The Commissioners also point out that as a result of the extension of the fishery, "increased means of employment and an ample supply of wholesome food have been furnished to the labouring classes Fishing villages have been erected, harbours built and extensive curing premises raised in the most complete style; and agriculture has been benefited and waste land reclaimed by the use of the offal of the fish as manure, arising from the practice of gutting having become general in consequence of the bounty being confined to gutted fish alone"

Scotland is still the leading herring-catching and exporting country Although the gross weight of herring landed in England now surpasses the Scottish total, it must not be forgotten that a considerable proportion of the fish landed on the east coast of England is caught by Scottish fishermen Scottish statistics of cured herring go back to the year 1811,[1] but the figures for the whole catch only go back to 1889 Approximately they are —

Scottish Herring Fisheries Total Catch

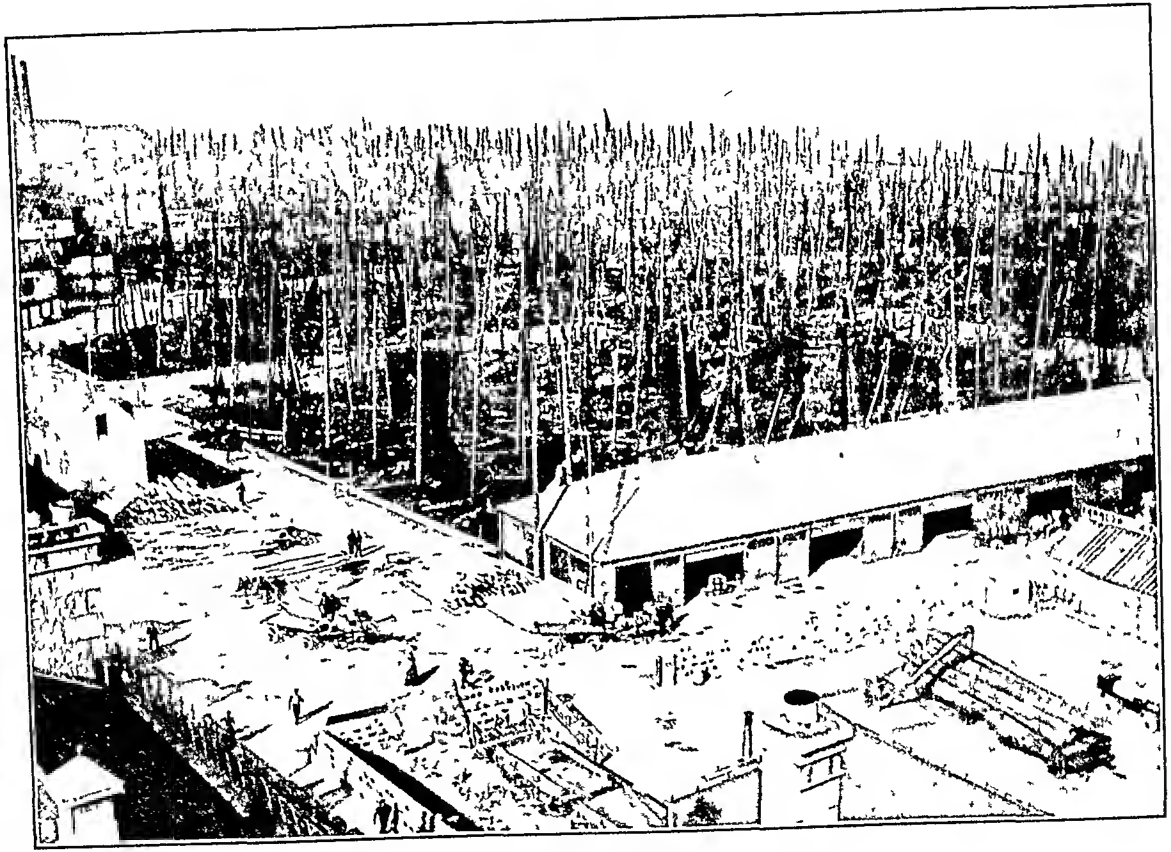
ANNUAL AVERAGES FOR DECENNIAL PERIODS

	Cwts (thousands)	£s (thousands)
1894–1903	4 014	1 007
1904–1913	5 267	1 564

The statistics exhibit a certain amount of fluctuation, but on the whole there is a steady increase The average for the first five years is 3,863 639 cwt and £805 611, for the five years 1900–4 it was 4 464 955 cwt and £1,185 426, and for the five years ending 1913 no less than (approximately) 4,983,000 cwt and £1,733 000

Since the curing of herring forms an important adjunct to the fishery in Scotland (p 48), some account should be taken of the cured fish and the export trade The Fishery Board give full statistics of this branch of the trade, and the difficulty in presenting its main features lies in selecting, or rather compiling, a table, which without being overloaded with figures, shall yet give the main points Care should be exercised, since in some of the Fishery Board's tables the figures represent the quantity of herrings "bung-packed," i e ready for export In other tables the corresponding equivalents in the "sea-stick" state are given, i e before the herring have "pined" or settled down in the barrels An allowance of from 20 to 25 per cent should be made in converting one set of figures to the other In the following table, five yearly averages

[1] See *Annual Rept Scots Fish Bd* for 1913 Appendix D II p 129 *et seq*



THE HERRING FLEET IN FRASERBURGH HARBOUR.

BARKING THE NETS

of the Scottish cured herring, and the exports for selected periods are given :—

SCOTTISH CURED HERRING
(ALL FIGURES ARE AVERAGES EXPRESSED IN BARRELS)

Years.	Total cured seasticks.	Exported to					
		Germany.	Russia.	Whole Continent.	Ireland.	Out of Europe.	Total.
1872–76	850,966	519,769	46,038	573,413	27,703	2,153	603,469
1900–04	1,669,287	941,453	277,245	1,239,187	13,090	43,270	1,295,546
1909–13	2,034,986	790,995	666,466	1,443,612	5,183	83,000	1,534,870

PERCENTAGE OF TOTAL EXPORTS

1872–76 . .	86	7·6	95	4·6	0·4
1900–04 .	72·6	21·4	95·6	1·01	3·3
1909–13 . .	51·5	43·4	94·5	0·33	5·4

The year 1872 is selected because it was then that the German herring fishery was established.

ENGLAND

In 1913 the English herring fisheries produced 7,313,425 cwt. of herring, valued at £2,325,084. The predominance of the east coast will be seen from the following detailed returns: east coast, 6,935,413 cwt., west coast, 275,632 cwt. and south coast, 102,380 cwt.

The value of the fish is that when first landed, there are no statistics of the cured herring trade published by the Board of Agriculture and Fisheries, and no estimate is possible of the value of the cured product. Herring is the only fish which is cured to any considerable extent in England, and according to the Census of Production Tables (1907), 466,000 cwt. and 521,000 barrels of herring were cured in England in that year; this total including kippers, bloaters and reds. The value of the cured herring is given as £737,000.

The headquarters of the English herring fishery have always been at Yarmouth,[1] and there is a considerable volume of documentary evidence as to its antiquity. These records go back to the eleventh century or even earlier.[2]

[1] There is much interesting information about the Yarmouth fisheries in *The Herring*, by A. M. Samuel. London. John Murray, 1918.

[2] See J. M. Mitchell, *The Herring, its Natural History and National Importance*, Edinburgh, 1864, p. 136. Mitchell is, however, not very reliable. In his statement about Dunwich he makes four errors (p. 136). Dunwick should be Dunwich, Norfolk should be Suffolk, 2400 herrings annually should be 24,000 herrings annually, and finally he misquotes the page in Anderson's *History of Commerce*, from which he derives his (mis)information.

The Yarmouth and Scottish fishings are quite distinct, the former being much later in the year, and it is customary for vessels to fit out for both The Yarmouth fisheries naturally shared to some extent in the vicissitudes of the Scottish fisheries already described While the method of fishing is identical at both fisheries, the cured product is, in the main, dissimilar, the Yarmouth herring being usually dried or smoked

In the fourteenth century there are numerous references in State and other papers to these herring and herring fisheries In 1338, fifty six lasts of herrings are mentioned in a list of provisions for the English Army in France [1]

Later in the same century (1357 and 1360) the Statutes of Herring give one a good idea of the state of the fisheries By the first it was enacted that herring should not be sold at sea, but " brought freely and unsold into the haven of Yarmouth," where the fair was kept People were forbidden to buy herrings to hang in their houses " by covin," nor in other manner, at a higher price than 40s per last, containing 10,000 herrings Neither shall any pyker (a small vessel) practise the buying of fresh herring in the haven of Yarmouth, betwixt Michaelmas and the feast of St Martin The later statute removed some of the restrictions on the sale of herring

One of the earliest accounts of the Great Yarmouth herring fisheries which has any value is that describing the condition in 1791 [2] At this time the fishery commenced on the 20th September and continued through October, November and part of December The average value of a fishing boat was from £500 to £600, some costing as much as £1000 Boats of about 50 tons were considered to be best adapted for the fishing Each boat carried a number of nets corresponding to the tonnage A " dole " is two nets of 21 yd each in length, 4 lints broad, fifty two meshes in each lint The nets are all barked with great care, and when fit for sea a dole is valued at £3 3s The decked boats carry two masts which they can set or " duff," and which they commonly do when they set the nets, and let the vessel drive with the tide The nets were worked by a capstan Each boat carried twelve hands, and usually stayed at sea three, four or even six days The fish were salted in the hold and brought home for curing red Returns had to be made at the custom house, for bounty purposes At this time the business at Yarmouth was entirely for red herring the chief market being the Straits This year about fifty vessels were fitted out from

[1] *An Historical and Chronological Deduction of the Origin of Commerce from the Earliest Accounts* 4 vols London 1787 by Anderson Vol I p 307

[2] *Second Report on the State of the British Herring Fisheries* 1798 p 254

Yarmouth, and between thirty and forty from Lowestoft. Vessels came frequently from Holland, but were not allowed to sell their herring at Yarmouth. "They have an excellent mode of barking their nets (i.e. the local boats), 27 bushels of bark to eighty or ninety nets." One-fourth of the nets were renewed annually. All the nets were of the same dimension, namely, thirty-four meshes to the yard, catching fish about 1000 to the barrel.

A study of the statistics of the Yarmouth herring fishery for the period 1739–1782, shows that on the whole the red herring fisheries were declining.[1]

The total number of barrels of red herring prepared at Yarmouth, both for domestic and foreign consumption, sank from 51,859 in 1739 to 18,802 in 1782. In the ten years, 1788–97, of a total export from England of 129,635 barrels of red herring, only eighty-six went to Russia, twenty-five to Prussia, 1234 to Germany, the chief markets being the "Streights and Gibraltar" and the West Indies.[2]

In 1913, which was the last complete herring season at Yarmouth prior to the war, the fishery was the most prosperous ever seen, either in East Anglia or elsewhere. The catch for Yarmouth and Lowestoft was approximately 1,360,000 crans, Yarmouth's share being 823,600 crans and Lowestoft's 536,400. This total was 17,000 crans more than the united spring and summer catches of Scotland and Northumberland, and its value to the fishermen alone was about £1,350,000; since the average price realised on landing was not less than a pound per cran. Over 1000 vessels participated in the fishing from Yarmouth and over 600 from Lowestoft. Scottish fishermen were responsible for 34 per cent of the catch, no less than 1163 Scottish boats taking part in the fishing. Scottish fishermen would have taken an even greater share but for their habit of returning home with the November moon; after which, in 1913, considerable catches and high prices were recorded.

Isle of Man

It is impossible to do more than glance at the herring fisheries of the Isle of Man, although they have been from time immemorial a source of food supply and revenue to the island fishermen.

In 1610, upon a Tynwald holden in June, the Lieutenant, Deemsters, Officers and Keys being assembled, an Act was passed for the regulation of the herring fishery, which "is as great a blessing as this poor island receives." It was enacted that all farmers and tenants were to be prepared with nets for the fishing, which was

[1] *Third Report on the State of the British Fisheries*, 1785. App. VIII, p. 61.
[2] *Second Report on the State of the British Herring Fisheries*, 1798, p. 277.

not to commence before the 16th July (old style) Herring scowtes were to be of 4 tons burthen, and a weekly close time was prescribed Some of the clauses of the Act would seem strange to modern fishermen, "if any of the fleet do, by God's blessing, meet with the scul of fish, or get good store thereof, and reveal not the same to the next boat to him, so that the same might be discovered from boat to boat, throughout the whole fleet, to the end every of them might be partakers of that blessing, every one so offending is to be fined 40s, besides imprisonment" The water bailiff or admiral was to cause the fleet to be assembled where the shoals were located, his reward for this service being "a certain measure called a Kybbon full of herrings, or twelve pence in money in lieu thereof" For a long time the inhabitants of the island prosecuted this fishery with a view of laying in a stock of food for their families in the winter, and until recently the peasantry of the island were skilled in the preservation of herring For the five years preceding 1771 only 7667 barrels of salted herring were exported from the island In 1772 the Government encouraged the fishery, e g in the shape of cheap salt and light duties, so that in the five years preceding 1782 the export of herring amounted to 104 537 barrels During this period the island supplied upwards of 1800 sailors to the Navy and the British Mercantile Marine [1]

Norway

In Norway the herring fishery consists of a summer fishing for fat herring, a spring fishing for spawning herring and a winter fishing for large herring (storsild) There is also a fishery in Norwegian waters for small herring (smaasild) The North Sea and Icelandic catch by Norwegian fishermen is also shown separately, so there are six separate enumerations of the Norwegian herring fishery in their official statistics The quantity taken is large, and the export considerable Of recent years the Norwegians have specialised in the preparation of herrings and sprats in the form of the so-called delicatessen This branch of the trade in canned goods has grown by leaps and bounds, the attention of the herring trade in the British Isles should be directed to it In 1912 the leading feature in the Norwegian fishery was the enormous quantity of herring put up in the form of canned goods Between 60,000 and 70,000 "Maal," each of 150 litres were so prepared, practically all for the export trade The bulk of this canned herring is spring herring, which is retailed as canned "kippers" The following

[1] *Third Report on the State of the British Fisheries* 1785 p 153

table gives the total quantity and value of the Norwegian fishery in the years mentioned.

HERRING FISHERIES

Years.	Quantity. Hectolitres in 1,000.	Value. 1,000 kroners.	Years.	Quantity. 1,000 hectolitres.	Value. 1,000 kroners.
1866–70	1,377	7,451	1901–3	1,338	7,725
1871–75	1,250	6,445	—	—	—
1876–80	998	6,314	—	—	—
1881–85	645	5,024	—	—	—
1886–90	1,209	4,224	1910	2,594	11,678
1891–95	1,462	5,077	1911	2,796	10,450
1896–1900	1,308	6,410	—	—	—

It is evident that since 1885 the Norwegian fisheries for herring have increased considerably in importance. Taking a ton as being equivalent to 12·7 hectolitres, the quantity landed in 1911 would be 4,404,400 cwt., valued at £580,570, a very low value compared with Scottish or English herrings.

Sweden is the chief market for Norwegian salted herring, though some are sent to Germany.

Norway now stands third on the list of herring importers into Germany.

DENMARK

The earliest " great " herring fishery of which we have historical record was that carried on from Scania, in the Baltic.[1] This fishery was commercially as important as that of the Dutch a few centuries later, or as that of Scotland at the present day. Scania, with its two important fishing villages, Skanör and Falsterbo, though now situated in the extreme south-west of Sweden, belonged to Denmark until the seventeenth century. From this province Catholic Europe derived its supply of herring for over three centuries.

The fishery lasted from Our Lady's Nativity (8th September) to All Saints Day (1st November). It is uncertain when this fishery first became of more than local importance. The historian Saxo refers to it as a considerable fishery in 1180, but it was probably not until the rise of the Hanseatic League that this herring trade acquired a European reputation. The fishermen of Lübeck took part in the fishery as early as 1201, since in that year " when they lay with their vessels at Skanör, at the herring fishing," they were

[1] See " Our Sea Fisheries," by Dr. T. Wemyss Fulton, *Fish Trades Gazette*, 11th November, 1893; and Fischer, F.C.J., " Geschichte des Teutschen Handels " (Hannover, 1793. 4 vols.), Vol. I, p. 690.

stopped by Knut the Sixth, who confiscated both ships and goods [1] According to Philip de Masieres,[2] in 1382, 40 000 boats, 500 freight ships and 300,000 men were employed in this fishery [3] This is probably a gross exaggeration, though by this time the fishery was a flourishing and important one Two centuries later, the Lubeck bailiff—who would be unlikely to overestimate, because the Danish king collected taxes from the fishery—stated that 7515 boats were employed, each manned by five men, a total of over 37,000 fishermen

Along the coast the land was divided into separate areas, the representatives of the various foreign communities having their own spaces, marked off by boundary stones On these plots were built the company-house, booths for storing barrels, sheds for curing and a church The fishermen's quarters were quite distinct These latter were almost exclusively Danes, there were a few Germans from the Hansa towns The fishermen's booths were sheds of timber or wattled work, or tents of mats or canvas, and each was occupied by one boat's crew, consisting of the skipper (styrman) and four or six oarsmen (rorkarlar) Each man provided his own nets, and payment was by share, the skipper getting two shares So far as is known the boats were open and propelled by oars The nearest modern approach to these old Scandinavian boats of high stem and stern is seen in the " fourerns " and " sixerns ' of the Shetlands The fishery, like the Lammas fishing on the east coast of Scotland, was for spawning fish, which came near the shore Nets were either drift (drifgarn) or set, i e anchored (sattgarn) These latter are still used on the west coast of Scotland (Ballantrae Bank) and Wales (Cardigan Bay) The set nets were sunk to varying depths by means of anchors or stones, but only one breadth of net was used, and they were kept erect by buoys, usually kegs Several nets were attached together to form a fleet (lank), and at the end was placed an upright staff with a flag or bundle of twigs Probably the set net is the more ancient, at any rate they were much the more common in the earlier years, and even in 1494 there were only 141 drift net boats to 460 set net boats at Skanor and Falsterbo

The *drift* nets were always shot outside the *set* nets The fishery regulations were precise and draconic They related to a great variety of subjects—the distance from shore at which the nets were

[1] There is reference to this fishery at this period (*circa* 1203) in the continuation of the *Chronicon Sclavicum of Helmoldus* by Arnoldus published by Lindenbrogius Hamburgh See also Anderson *History of Commerce* Vol I p 240

[2] Le Songe du vieux Pelerin (*circa* 1389)

[3] In 1394 this fishery was totally interrupted by pirates Werdenhagen *Tractatus de Rebus publicis Hanseaticis* Vol II p 366 In 1417 the Lübeckers were again imprisoned by the King of Denmark (Eric IX) See *Chronica Slavica ante*

to be shot, the space between each net, the time of shooting, as well as the handling of the fish. In the earlier enactments the punishment was loss of life and goods, and the Lübeck merchants were in the habit of bringing their own executioner to execute justice on offending fishermen. No fishermen, except at the risk of his life, could leave for the fishing grounds without his net. Before sailing he had to procure an official permit (tecken) from the bailiff, and on his return he had to furnish a statement of the quantity of herring caught. Failure to comply meant capital punishment. Those were the days for the official collectors of fishery statistics !

On the other hand, the curer was compelled to buy the herrings, failure resulted in a fine, and the salted herring were handed over to the fisherman. From the records it appears that a fisherman's life was worth from three to forty marks, that is about the price of a barrel of herring. There was no prohibition of Sunday fishing in the old laws, as early as 1160 the Pope, Alexander III, gave permission to the people on the Germanic coasts to fish for herring on Sundays and holy days, a right which French fishermen possessed till the Revolution. In 1386 the curers complained that the meshes of the nets were too small, with the result that immature herring were taken. Competition was keen, even in those early days of the herring trade, and we read of the curers riding into the water to bargain with the fishermen before the boats reached the land.

This was eventually prohibited, and no herring were allowed to be sold before sunrise, an official signal being hoisted to inaugurate the sales. The curing lay entirely in the hands of the foreign merchants. In early days the bulk of the fish were made into reds, but even from the first large quantities were pickled. It was illegal to place small or inferior herring in the middle of the barrels, and the fish had to be all salted alike and packed in regular layers. Salting and packing were done by women under the supervision of the curers, and gutting-women (gælne-konner) were employed at least as early as 1494. There was some difficulty in agreeing on the size of a barrel. Those of Lübeck, Rostock and Stralsund were larger than from the smaller towns, small barrels being often made with fraudulent intent. Luneberg salt was preferred, French salt from Baye being considered inferior. In early times herring were sent direct to England and Flanders (i.e. as sea-sticks), but the vast majority were sent to the Hanseatic towns to be sorted and repacked in barrels specially stamped by sworn markers (herinck-wracker). The complicated marks and brands were burnt in on the barrel. Full herring were distinguished from spents, and those

from Scania from those caught further up the coast at Marstrand; each great Hansa town, Lubeck, Dantzig, Stettin, had its own special brand

The best class were stamped on the bottom, the inferior on the bilge Selection, sorting and packing were thoroughly performed, there being no less than ten district brands for the Scania fish alone, almost everything affecting the quality or condition of the fish being indicated on the outside of the barrel The result of this was that the Scania fish captured the market until the Dutch herring drove them out Even after the Great Dutch Herring Fishery had become established the Scanian fish were preferred, and in 1418 the curers at Kampen (Zuidersee) were compelled to fly a red flag at their yards when they were curing other than Scania herring, so that buyers might not be deceived Scania herring were sent all over Europe, east to Russia as far as Novgorod, to Prussia and Poland, west to France, England and Holland, and south to Silesia, Moravia and Bohemia In France in the fourteenth century barrelled herring from Scania were the only kind officially recognised by the "gardes du métier," others being classed as "herens contreffais" or counterfeit In England as early as 1400 the Hansards annually presented the Lord Mayor of London two barrels of Scania herring In 1449 the sale of herring was prohibited before the arrival of the Scanian merchants In 1437 fourteen barrels, "allecum salsorum de Scone," were bought at Leith for the King of Scotland, for which £18 18s were paid The price of Scania herring at Stettin from 1395 to 1443 varied from 6s to 44s per barrel

Sweden

The chief Swedish fishery is for winter herring in the northern Cattegat and the eastern Skager-Rack, and is generally carried on *nearer the Danish than the Swedish coasts* *It commences in* November and ends in mid-February In the season 1912–13 the catch amounted to about 861,420 cwt, value £205,555

Although Sweden is not an important country for cured herring, 36 000 barrels of herring were salted in Bohuslan during the season ending mid-February, 1913, and of these 14,000 barrels were exported to Germany and 20,000 to Russia The Bohuslan winter herring fishery depends largely on the purse seine, introduced from the United States, where it is used for the capture of mackerel This net can now be used either from the shore or in the open sea

Belgium

The famous seventeenth century herring fishery has practically disappeared. The catch is now insignificant ; in fact, in 1863 the fishery became extinct, but was resuscitated in 1907.

In 1910 there was landed at Ostend, from Belgian boats, 481 tons of fresh herring, value £4052. French boats sold 163 tons for £1000.

According to the " Tableau général du Commerce avec les Pays étrangers," the number of Belgian boats engaged in the small herring fishery in 1912 was 184, the value of the catch £3612. In the great herring fishery there were three boats engaged, and they landed 10,367 cwt. of herring.

Holland

The herring fishery is said to have been carried on off the coasts of Scotland by Scotsmen in the ninth century. Owing to the Convention of the Royal Burghs having passed an edict, prohibiting the exportation of herrings until the townsmen were fully supplied at a stipulated price, the fishermen gave up the trade, and a number went to Holland with their fishing boats and settled there, continuing to fish off the Scottish coast. This is said to have been the means of directing the attention of the Dutch to the herring fishery on the coasts of Scotland and England.[1]

Whether this view be correct or not, there can be no doubt about the supremacy of the Dutch in the herring fisheries during the sixteenth and seventeenth centuries. After the discovery of Beukels, already referred to, the Dutch herrings acquired a reputation which those of no other country could attain. This reputation was due to the great care which was employed in preserving them when caught, and in curing and packing them. Laws and regulations were established not only respecting the time and manner of fishing, but also respecting every step to be taken in the preparation of the herring for sale.[2] Many regulations affected the conduct of the fishermen when at sea to prevent them from molesting, impeding or injuring one another. Fishermen are particularly enjoined to pay their people only with money, and not with herrings, fish of any kind, merchandise or provisions.

[1] Gerard Malynes, " Consuetudo vel Lex Mercatoria," folio 1622, p. 189.

[2] For these and many other interesting regulations of the " Grand Fishery," see " Groot Placaet-Boeck vervattende de Placaaten Ordonantien onde Edicten van de Doorluchtige Hoogh Mog. Heeren State Generael der Veernighde Nederlanden by een gebracht door M. Cornelis Caus' Graven Hage," 1658, in 8 vols. See especially Vol. I, pp. 692–750.

The season for fishing was from midsummer to the last day of January. No herring were to be sold, but the whole catch had to be brought into the harbours of Holland and Zealand. To preserve them until their landing they were to be properly packed in barrels and salted, so that on arrival in port they might be transferred into other barrels and finally cured for sale or exportation.

Every care was taken in the construction and quality of the barrels. An office was established in every place where barrels were made, and a person was appointed to examine and mark them with a brand, if found satisfactory. All defective barrels were broken up. The number of staves of which each ought to consist was accurately determined, as well as their breadth and thickness, and they were to be bound with strong and sufficient hoops. They had to be made of good, dry and heavy wood, the bottoms to consist of no more than three pieces, but fewer if possible. The use of old barrels for curing herring was strictly prohibited. No fresh herring could be landed in Holland, to be salted for sale or cured in barrels, and it was required that all herring should be cured within three weeks after being brought into Holland. Equal care was bestowed on the selection of the salt. French salt, West Indian and Isle of May salt were prohibited, the kinds permissible were Spanish and Portuguese, but even these could not be taken to sea, or used, until they had been inspected by a *keur-meister*. In packing herring, those bad or damaged were to be rejected, and none was to be cured except under the direct supervision of a *keur-meister*, and in some public building accessible to all.

Herring could not be sold in Holland until they had lain ten days in pickle, and if foreign herring were brought into the country it was strictly enjoined that they should not be repacked in Dutch barrels. The salt used in the herring trade was exempt from duty, and the fishermen were privileged during the fishing season, and could not be arrested for any debt unconnected with the catching or selling of fish.[1]

The nets employed in the fishery were from 50 to 60 fathoms in length, with the meshes of such a size that the fish might remain suspended by the gills. They were made of the best hemp, and some of a kind of coarse Persian silk.[2]

The vessels engaged in this fishery were from 70 to 100 tons burthen, and called "Busses." According to Dutch annals these vessels were first used in the year 1416. They carried a crew of from ten to fourteen men, besides the pilot or master, and the crews

[1] Martinus Schookus. Dissertat. de Harengis vulgo Halecibus dictis. Groningae, 1649. th. 118.
[2] Duhamel doubts this. Traite General des Pesches. Paris, 1772. Part II, p. 368.

were engaged at a weekly wage. The price of a new vessel completely rigged was usually about 9000 florins, and the expense of fitting out for two voyages was 6000, and for the third in the same year 8000 florins, the total expenditure for the year being 17,000 florins. A buss after three voyages was practically useless, all its gear was worn out and the hull was of little value. A tender usually accompanied every ten vessels of the herring fleet during the first part of the season. This tender was allowed to bring herring home up to the 25th July, after which no tenders were allowed.

From midsummer to the 25th July fishing was carried on in the neighbourhood of the Shetland Islands, and off Fair Isle; from the 25th July to the 14th September on the coast of Scotland off Buchan Ness; afterwards off Yarmouth, and from the 25th November to the 1st January along the coast of Norfolk.

Fishing was carried on at night, the fishermen being better able to discover the shoals by the luminous appearance they are said to exhibit when near the surface of the water. At one time the fishermen used lanterns, specially constructed, to attract the fish.

The nets were examined in the morning, when the fish were gutted and cleaned. They were then put into barrels and salted.

In 1620 Dutch vessels were forbidden under a penalty of 300 florins, to fish near the coasts of Shetland, Ireland and Norway; because the fish caught at these places were alleged to be of inferior quality, but really to meet James I complaints. Statistics of the fishing, in the modern sense, were not kept in those days. There is, however, reason to believe that in 1560 about 1000 vessels sailed from Dutch ports for the herring fishery, in 1610 the number amounted to 1500, and ten years later to 2000. The fishery continued in this flourishing condition for a long time, and, as already noted, the attempts of the Stuarts to wrest the supremacy from the Dutch were unsuccessful. It is estimated that at this time the herring fisheries yielded a revenue of 2 million guelders annually to the Dutch, giving subsistence to 450,000 persons actually employed in the fishing and subsidiary operations.[1] "The Dutch catch more herrings, and prepare them better, than any other nation ever will; and the Lord has, through the instrument of the herring, made Holland an exchange and staple-market for the whole of Europe."[2]

The continued prosperity of the Dutch herring fisheries naturally attracted the attention of other nations, who endeavoured to capture the Dutch trade, but it was really the numerous wars in which the

[1] John de Witt, "A representation of the wholesome Political Grounds and Maxims of the Republic of Holland and West Friesland," 1669. See also Fulton, *The Sovereignty of the Sea*, p. 126, *et seq.*

[2] Meynert Semeyns. Corte beschryvinge over de Haring visscherye in Hollandt, 1639.

Dutch were engaged which first led to a decline in her fisheries In 1653, owing to fear of the British fleet, the whole of the herring busses, still amounting to some 2000 sail, were kept at home The herring fishery was again forbidden in 1665 and 1666, and it was not until after the Peace of Nijmegen, 1678, that any return of prosperity attended the Dutch herring fleet [1] This was very fleeting

In 1702 the war of the Spanish succession brought the Republic and France into conflict, and this continued until the peace of Utrecht in 1713 The Dutch herring trade was not now in a position to recover rapidly, and certain of the restrictions on fishing and curing already referred to, were now a positive hindrance to development, whatever they may have been when first promulgated.

In 1736 the Dutch herring fleet numbered only 300 sail, and was still further reduced by 1779 to 162 [2] The Dutch Government now tried direct encouragement by means of bounties (1775), but without effect

The number of busses declined At this time the Danes captured a share of the herring markets, and, according to Thaarup,[3] from 70,000 to 80,000 barrels were cured every year at Christiansund, besides those cured at Drontheim and other places

At the end of the eighteenth century the Russian market for herring was estimated at more than 100,000 roubles,[4] and the Danes and Norwegians had at this period a preponderating share of this The imports at Konigsberg during the four years, 1763–67, shows this clearly —[5]

1763	Imports	418	barrels	Dutch,	16,349	barrels	Danish and	Norway.
1764	„	512	„	„	20,118	„	„	„
1765	„	667	„	„	22 686	„	„	„
1767	„	747	„	„	18,099	„	„	„

The Swedes, Prussians and French also made attempts to develop herring fisheries about this time The Swedes attempted the foundation of a herring company in 1745, and soon made considerable progress [6] In 1764 and 1765 we read of complaints of Swedish herrings to the amount of 20 000 barrels being imported into Ireland and thence shipped to the British Colonies [7] In 1776 the number of barrels sent to Ireland was 56,000

[1] Beaujon *The History of the Dutch Sea Fisheries*
[2] Posselt *Europaische Annalen 1797 Part II*
[3] *Versuch einer Statistik der Danischen Monarchie* Kopenhagen 1795 Vol I p 407
[4] Storch *Hist Stat Gemälde der Russichen Reichs* Vol II p 96
[5] F S Bock *Versuch einer vollstandigen Natur und Handlungsgeschichte des Hering* Konigsberg 1769 p 86
[6] M E Bloch *Œkonomische Naturgeschichte der Fische Deutschlands* Berlin 1783 Erster Theil p 261 (The octavo edition)
[7] Macpherson *Annals of Commerce* Vol III pp 459 and 726

About the year 1784 there arrived annually in Brassa Sound between two and three hundred Dutch-Iceland ships of 80 tons, and two or three hundred Dutch herring busses with two convoys or hospital ships.[1]

The statistics of the Dutch herring fishery refer to the "Great" or "Salt" herring fishing, carried on off the east coasts of the British Isles, the fish for the most part being cured on board. These statistics are very detailed and go back for more than a century.

For the most part the Dutch boats fish for the so-called summer herring in the neighbourhood of Lowestoft, where vessels from Scheveningen may be met with every year. At the early or spring herring fishery off the west coast of Scotland and off Stornoway in 1907, only a few Dutch boats participated, and none in 1908.

At the Scottish winter herring fishery in 1907 and 1909 no Dutch boat took part, and in 1908 only one. On the other hand, there were eight or nine Dutch steam drifters fishing for herring in the Channel off Boulogne in 1907 and 1908, and seventeen steamers in 1909. At the Scottish summer herring fishery a considerable number of Dutch herring boats are engaged.[2]

In the middle of the nineteenth century the Dutch herring fishery was at a very low ebb, from 1850 to 1870 the highest annual catch was 42,000 barrels, the lowest 16,000. A great recovery has since taken place, the catch in 1903 amounting to 813,728 barrels, and in 1910 (including salt and green herring), 781,826 barrels. The annual average for the five years, 1906–10, was 774,893 barrels. At the time of the founding of the German herring fishery (1872) it was 76,283 barrels.

As may be seen from old prints the Dutch herring fisheries were carried on for years, possibly for centuries, by means of "Busses"[3] or "Hookers," and these craft persisted until well on in the nineteenth century. They were low, barge-like vessels with a conspicuously high mast and square mainsail, a running bowsprit with jib and stay-foresail, which must have been to a large extent shut off by the mainsail. There was also a small topsail for use in light winds. A small mizzen-mast with triangular sail was useful in keeping the hooker to the wind. The crew was a large one, usually

[1] "General remarks on the British Fisheries by a North Briton" (London, 1784), p. 30. Republished in 1785 with author's name, Thomas Gordon.

[2] In 1912 876 foreign fishing vessels visited Lerwick, in 1911 721, and in 1910 647. Of these about three-fourths are Dutch, one-sixth German and the rest Scandinavian, French, Danes and Belgians.

[3] An interesting description of the construction of a Herring Busse is contained in "The Herring Busse Trade, Expressed in Sundry Particulars," by Simon Smith, Agent for the Royal Fishing, 1641, already quoted in part, *supra*, p. 106.

from fourteen to sixteen men and boys, and there can be no question but that these hookers were extremely heavy vessels to work. About 1858 the old hand-made hemp nets were replaced gradually by factory made cotton nets from Scotland, the hookers being extensively replaced by the bom schuits. These vessels closely resembled the hookers in the construction of the hull, but the rig was completely altered. The mainmast was shortened, the mainsail being replaced by a fore-and aft sail with a short gaff. Sometimes a small mizzen was retained and all these bom-schuits carried a lee-board. A hand capstan was carried and the rig being much easier to work, the crew only consisted of eight men. Still later sailing vessels of the model and rig of the English first-class sailing trawler were introduced into the Dutch herring fisheries, these vessels being fitted with a steam capstan have quite outclassed the bom schuits. As will be seen from the following statistics, the Dutch have only gone in sparingly for steam drifters, but it must not be forgotten that the Dutch fishermen do not, like the Britisher, run into port daily with their fish.

Most of the Dutch authorities attribute the revival to the abolition of the monopolies in 1857–9, and the Government brand in 1878; other causes were the introduction of cotton nets, and particularly the use of keeled vessels, cutters and luggers for the heavy old "hookers." In 1872 the Dutch herring fleet consisted of 108 keeled vessels and 208 bumboats, the total number being 316; in 1903 there were 463 keeled vessels, 268 bumboats, 44 steam drifters, 1 motor vessel and 5 logger-bommen (a composite type), the total being 781. In 1910 the numbers were 500 keeled vessels, 38 steam drifters, 1 steam lugger, 3 sailing vessels with auxiliary steam engines, 5 motor boats, 6 logger bommen, 167 bommen, total 720.

The remarkable *increase in* the Dutch herring export trade is shown in the following table:—

Average annual export	1861–70	19 710 barrels
,, ,, ,,	1871–80	75 322 ,,
,, ,, ,,	1881–90	227,200 ,,
,, ,, ,,	1891–1900	316 308 ,,
,, ,, ,,	1901–05	575 560 ,,
,, ,, ,,	1905–09	575,744 ,,
,, ,, ,,	1910	619 493 ,,

In view of the intense competition that now exists for the herring markets, the statistics of the trend of the Dutch exports are not without interest.

BARRELS OF HERRING

	To Germany.	Belgium.	America.	Other parts.	Total.
1880–3	103,734	19,973	13,624	5,267	142,598
1884–7	196,978	23,038	15,918	11,935	247,869
1888–91	224,036	19,987	15,876	9,465	269,364
1892–95	227,225	25,891	21,990	12,765	347,671
1896–9	224,026	26,161	36,620	15,631	302,438
1900–3	377,273	28,781	70,071	43,762	519,887
1904–5	418,940	35,343	67,740	67,793	589,816
1906	446,880	44,260	77,347	45,080	613,567
1907	393,453	47,167	51,807	51,966	544,393
1908	361,247	44,560	51,853	41,940	499,600
1909	506,793	49,846	57,620	31,167	645,427
1910	461,973	52,447	66,980	38,093	619,493

GERMANY

The first attempt of the Germans on the herring fishery was made in 1770, when six vessels sent from Emden to the coast of Scotland returned with 130 lasts of herring.[1] The number of these vessels increased so that in 1782 they amounted to thirty-four, but it does not appear that this fishery ever acquired any importance, and nearly one hundred years elapsed before the Germans renewed their attempts to capture the herring markets.

Cured or pickled herring has for some considerable time been a staple food of the industrial classes in Germany and Central Europe. There is evidence that this was the case as early as the middle of the fourteenth century; at any rate, a regulation was made in 1569 in Würtemberg to the effect that the grocers and provision merchants of Stuttgart shall provide themselves with a good supply of herring, and retail the same at five heller apiece, so that the poorer classes shall not lack sufficient food.[2]

The recent history of the German herring fishery is of particular interest, since it was originated in 1872 with the avowed object of capturing the home market for cured herring. In that year a company was started at Emden with a capital of £21,000. They purchased from a Vlaardingen firm, whose head was a German by birth, six luggers of the newest construction, and the crews and management were both Dutch.

In addition, the company obtained substantial advantages from the Government, but in spite of this and with a protective tariff and an immense national market behind them, it was many years before any real progress was made. The difficulties were great,

[1] Bloch, *Naturgeschichte der Fische Deutschlands*, Erster Theil, p. 262.

[2] von Scherzer, *Das wirtschaftliche Leben der Völker*, Leipzig, 1885, p. 439.

since the fishery is only possible during a portion of the year and is liable to violent fluctuations In the first year of their work the six luggers caught 3785 barrels, which realised 147,777 marks (about £7250), in the next year they had nine luggers in 1875 eleven, and the number remained at this total until 1882 After that they increased by about a lugger a year In 1890 there were seventeen in 1895 the number was fifty-two, and in 1898, when steam drifters first made their appearance in the German herring fleet, there were eighty five luggers and five steamers

In 1909 there were 190 luggers and eighty steam drifters

Five-yearly averages from 1872 give the following results —[1]

	Vessels		Number of barrels	Value in marks	Mean increase in number of barrels
	Sail	Steam			
1872–76	10	—	4 252	194 968	
1877–81	11	—	5 112	197 468	860
1882–86	13	—	9 402	312 024	4 290
1887–91	21	—	12 908	363 845	3 506
1892–96	39	—	39 258	925 060	26 350
1897–1901	104	6	89 060	2 623 780	49 802
1902–1906	146	19	219 336	5 977,008	130 276
1907–1911	186	74	424 303	8 979 233	204 967
1912	180	88	299 659	8 400 000	—

The main features of the statistics of the great herring fisheries as outlined above, are the enormous production and the steady increase in every country When one considers that in the period under review the price has risen rather than fallen, it is clear that the demands of the markets are by no means satisfied

The development of the Dutch herring fishery is most remarkable, and it must be remembered that both the fishing and the trade are entirely free and not supported by the Government in any of the ways in which the German industry is helped The next table which gives the imports of salt herring into Germany, shows how formidable a competitor Holland has become in the great herring markets [2] It must, however, be noted, that the German official statistics as to imports differ widely from the export statistics of the various countries concerned In particular the Dutch total is greater in the German table (imports) than in their own table (exports), similarly the figures for Great Britain in the German official table (imports) are much less than in the British tables (of exports)

The following table shows also that although the German pro-

[1] The earlier figures are from the Geschaftsberichten der Emder Heringsfischerei A G later from Statistischen Handbuch für das Deutsche Reich and Statistischen Jahrbuchern für das Deutsche Reich [2] See Appendix VIII p 282

duction of salt herring has materially increased in the period under review, the imports have at the same time increased substantially, with fluctuations due to the uncertain nature of the fishery.

Since the imports are only given from the important countries, the totals do not agree with additions of the detailed figures.

In Appendix VIII (p. 282) the statistics of the German salt herring trade are given for the period from 1885 to the present time, and in the following table these statistics are expressed as percentages of the total foreign imports into Germany for quinquennial periods from 1885 to 1909.

It will be noticed that in spite of the tariff on imported herring in Germany, and the determined efforts of the German Government to establish a herring fishery, the British export of herring to Germany has more than held its own in this period. The Dutch exports have increased from 21 to 36 per cent and the Norwegian export to Germany declined from 20 to 8 per cent in the same period. While the German herring fishery has increased remarkably in this period, they have, after all, only succeeded in capturing a portion of the natural increase due to the increase of population in the German Empire.

GERMAN SALT HERRING TRADE

PERCENTAGES TO TOTAL FOREIGN IMPORTS

	Germany's own catch.	Great Britain.	Holland.	Norway.	Sweden.
1885–89	1	49	21	20	—
1890–94	1	45	28	21	—
1895–99	7	51	26	18	—
1900–04	14	52	35	11	—
1904–09	28	52	36	8	—

The imports of fresh herring and sprats into Germany are large, and up to the outbreak of war, so far as the latest available statistics go, were rapidly increasing.

GERMAN IMPORTS (FRESH HERRINGS AND SPRATS)

ANNUAL AVERAGES 1899–1909, IN DOUBLE-ZENTNERS ($220\frac{1}{2}$ LB.) FROM

Years.	Total.	Denmark.	Great Britain.	Norway.
1899–1904 . .	·410,644	55,341	215,323	43,595
1905–1909 . .	949,091	92,400	376,561	175,955

Years.	Sweden.	Belgium.	Holland.	France.
1899–1904 . .	72,850	12,820[1]	8,470[1]	4,762[1]
1905–1909 . .	265,095	6,361	9,784[2]	6,297[3]

[1] 1901–04 only. [2] 1905–07 only. [3] 1907 only.

An attempt is made in the following table to estimate the yield of the herring fisheries of Europe Since some countries return the quantity of herrings landed in units of weight e g cwts in England and Scotland and others in units of capacity e g Norway in bushels or even in numbers as in Denmark where the fish are returned as scores it follows that in the case of some countries the returns are only approximate The value fluctuates so largely as to be useless as a measure of comparison of the weights

HERRING FISHERIES OF EUROPE

		cwts	£s
England (1913)		7 313 425	2 325 084
Scotland (1913)		4 449 323	2 087 754
Ireland (1913)[1]		420 620	159 457
France (1911)		846 503	529 739
Germany (1913)	Fresh	148 354	75 738
	Salted	1 030 039	563 033
Holland (1911)		1 685 751	919 973
Norway (1912)		4 404 400	580 570
Denmark (1912)		845 295	140 051
Sweden (1912)		*861 420*	*205 555*
Belgium (1911)		13 000	5 000
Total		22 018 130	7 591 954

Of th s total 2 488 183 cwt value £763 256 were landed by Scottish boats and men

[1] 102 074 cwt value £40 572 landed by Scottish boats and men

CHAPTER VI

THE DEVELOPMENT OF STEAM TRAWLING

IN the early part of the nineteenth century the principal method of catching demersal fish in the North Sea was by means of hooks and lines, at first " hand " and subsequently " long " lines. The vessels employed were welled-smacks, their longest voyages being to the Dogger Bank. The well was situated amidships, about half the vessel's depth being pierced for free circulation of sea water. A description of these vessels is given by Holdsworth,[1] according to whom the use of wells for keeping cod alive was first tried in 1712 at Harwich. The welled-smacks of Harwich were probably the best known, but London also possessed a fleet of these vessels. In those days the use of ice for the carriage of sea fish was unknown, and fresh fish could only be brought in by well boats. Ice was first introduced for this purpose at Yarmouth in 1854; this led to the substitution of railway carriage of fish to London, for sea carriage. The well smacks were gradually ousted by the sailing trawler.

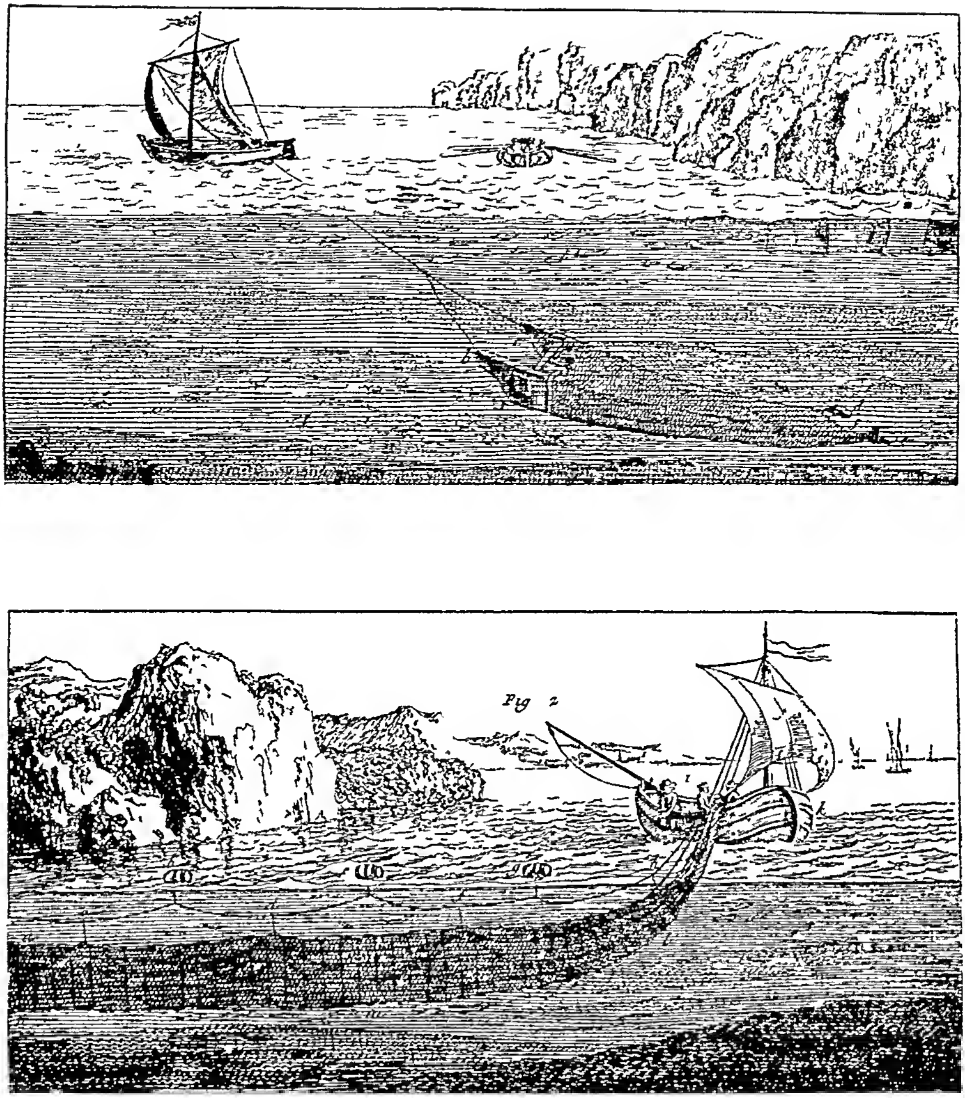
Trawling, though a very old method of fishing, was confined to small vessels in the neighbourhood of Brixham and in the estuary of the Thames, until the end of the first decade of the nineteenth century. After the Napoleonic wars the Brixham trawlers began to migrate eastward; there are records of them at Dover, Ramsgate (1818) and Harwich (1828). The Dutch coast was visited about 1830, and the Dogger a few years later. In 1837 there was a great boom in trawling owing to the discovery of the Great Silver Pit, south of the Dogger. This ground was frequented by enormous quantities of soles. Hull was found a convenient base from which to work this ground. Trawling can now fairly be considered to be established in the North Sea.

Somewhere about 1858, trawling became established at Grimsby, now the leading fishing port in the world. The operations of the trawlers were gradually extended, in 1860 the grounds off the coasts of Holland and Schleswig were fished, as well as the whole of the Dogger Bank and large areas north and west of it, off the

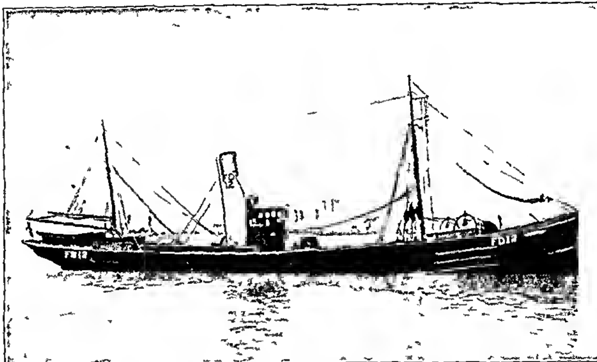
[1] *Deep-Sea Fishing and Fishing Boats*, by E. W. H. Holdsworth. London, 1874.

coasts of England and Scotland In 1875 the Great Fisher Bank was visited, about this time, or shortly afterwards, the attention of trawler owners was directed to the possibilities of steam as a propulsive power At one time Grimsby alone possessed a fleet of 890 smacks, all of which have now been replaced by the steamer The change from sail to steam dates from 1878, but the innovation was gradual, and it was not until late in the eighties or early nineties it became evident that the steamer was destined to supplant the smack The earlier steam trawler was a vessel of from 90 to 100 ft in length with engines of moderate power, a bunker capacity from 50 to 70 tons, and a fish hold of from 15 to 20 tons, the total displacement being from 250 to 300 tons In this early type the beam trawl was used Vessels of this description with the bridge abaft the funnel were in existence till quite recently In 1895 the otter trawl was introduced, and thus the efficiency of the steamer was much increased

Previous to 1891 practically the whole of the trawl-caught fish landed in the British Isles came from the North Sea In that year some adventurous trawler skippers paid a visit to Icelandic waters with astonishing results Accurate information as to their catches is not available, since the method of collecting statistics in vogue at that time gave no idea of the locality of capture, but only the port of landing It is only within the last few years that an attempt has been made to classify demersal fish according to their place of origin So successful were the first Icelandic trawlers that a large number of steamers followed them, with the result that nowadays nearly 20 per cent of our trawl caught fish comes from these waters Other distant regions have been visited in turn, so that trawlers working from home ports now sweep the seas from the White Sea to the coast of Morocco Nor is this exploitation of distant areas confined to British trawlers An even greater proportion of trawl caught Icelandic fish is landed in Germany Since the discovery of the Icelandic fishing grounds steam trawlers have fished off the Faroe Islands, and subsequently visits were paid to the Bay of Biscay, the coasts of Spain and Portugal, and finally the coasts of Morocco and the White Sea, while French steam trawlers now visit the famous banks of Newfoundland That our steam trawlers should have been compelled in such numbers to desert the North Sea and to seek new fishing grounds extending from the Arctic Circle to the Tropics is, in itself, a reason for believing the North Sea grounds to be undergoing a gradual process of depletion Long and hazardous voyages to the White Sea in the depth of winter are not undertaken for reasons of health It is stern necessity which compels our hardy fishermen to make such ventures



ANCIENT METHODS OF TRAWLING AND DRIFTING (CIRCA 1750).



A FLEETWOOD STEAM TRAWLER

As an instance of the risks to which British trawlers are exposed, it may be mentioned that in 1908, according to reports in the Press, a trawler's crew fell into the hands of Moors while fishing off the coast of Morocco, while another was wrecked in the White Sea and only saved from starvation by Laplanders. With regard to the productivity and the capabilities of the various fishing grounds now frequented by trawlers, there is much guesswork, but little real knowledge.

Obviously pioneers, who in one case christened a new ground "Klondyke," will not give away information which may be of service to their trade rivals. Exploratory voyages of an expensive nature, attended in many cases with considerable difficulties and dangers, may or may not be financially productive. In either case it is hardly to be expected that the trawler skipper will part with the information he has acquired at great expense of time and money. There are, however, certain facts relative to the various trawling grounds which are accessible. Some of these have been placed on record by the discoveries of scientific exploring vessels subsidised by one or other of the Governments of North-Western Europe. In other cases the information has been obtained from the commercial trawlers. Since most, if not all, trawler catches are sold by public auction at the quay side immediately on being landed, it is possible to obtain an estimate of the quantity, kinds of fish, and the total value realised by fishing for so many days in a certain area. Some of the results obtained in recent years on the various fishing grounds are of considerable interest. That the North Sea grounds have declined, and are still declining in productivity, cannot be gainsaid; and *pace* Herubal[1] this result is due to excessive steam trawling over an area which cannot be considered a small one, seeing that there are 147,000 sq. miles of trawlable ground in the North Sea practically, every square yard of which has been fished over. Not only are the North Sea grounds suffering from the effects of overfishing, but there is evidence to show that the Icelandic and White Sea areas and the hake grounds of the South of Ireland are undergoing a gradual process of exhaustion.

Some light was thrown on the North Sea problem by Fullarton[2] in his investigation of the trawling statistics of the port of Aberdeen. There can be no doubt that the study of commercial statistics, always provided they are reasonably accurate, is the best method of elucidating problems of overfishing. Attempts have been made from time to time to trawl in selected areas by means of a vessel

[1] *Sea Fisheries: Their Treasures and Toilers.* London, 1912.
[2] *Fish Trades Gazette*, 11th, 18th, 25th August, 1906, and 28th December, 1907.

specially detailed off for the work This method though it is undoubtedly of great interest and importance as giving us reliable pictures of the fauna and flora of any area, is, from the point of view of the study of overfishing, open to grave objections, the chief of which being that the limited number and frequency of the hauls, and the consequent paucity of fish militates against reliable conclusions being drawn There can be no question that as regards the study of overfishing, or the depletion of the fishing grounds owing to the efforts of man, the method of analysing reliable commercial statistics is infinitely preferable to studying the results of hauls taken from a single vessel, no matter how frequently those hauls may have been made and how carefully they may have been recorded

Fullarton shows from the Aberdeen statistics that from 1897 to 1903, both years inclusive, there was a steady progression both in the number and value of the steam trawlers engaged in fishing, and also in the quantity and value of fish landed The percentage return on capital invested in the trawlers diminished from 99 per cent in 1897 to 63 3 per cent in 1903 During this period, 1897–1903 there was an enormous development of the trawling industry at Aberdeen, the number of boats increased 258 per cent, while the capital invested increased by 370 per cent The quantity of fish landed increased by 275 per cent, its value by 238 per cent At the same time the earnings of the trawlers did not keep pace with the increase of capital In 1898 the high-water mark was reached, since when there has been a diminution of 43 per cent Had the earnings and capital advanced in an equal ratio, the value of fish landed in 1903 would have been £990,023, instead of the actual return of £637,551 Until 1903 there was a growth in the weight of fish caught per voyage, and till 1901 a corresponding increase in value, though the duration of the voyage had in the meanwhile advanced from an average of 3 9 days in 1897 to 6 8 days in 1903 This lengthening of the voyage is necessitated by the increasing scarcity of fish in the home waters

The expense of voyages to the more distant fishing grounds is considerable Steam trawlers burn from 6 to 8 tons of coal per day, the annual consumption per vessel running to between 1500 and 2000 tons or more, and as the coal is mainly consumed in steaming to and from the grounds, compared with the quantity used in actual trawling, except in deep water, it is evident for this reason alone that fishing at the distant grounds must be expensive Larger and more valuable catches must therefore be made to render the voyage profitable There is little exact information to show the difference in the catches on the various grounds, but the follow-

ing table gives particulars of voyages of a few Dutch trawlers in the months mentioned :—

RETURNS OF DUTCH TRAWLERS

	Average quantity (cwts.).		Average value (£s).	
	North Sea.	Iceland.	North Sea.	Iceland.
July (1903–5)	20	49	$12\frac{1}{4}$	$13\frac{1}{2}$
August (1903–5)	21	45	$13\frac{1}{2}$	$20\frac{3}{4}$

In these two months the average quantity per day for the North Sea was 20·4 cwt., and for Iceland, 46·8 cwt.

Prior to the discovery of the distant grounds there was a great outcry among the steam trawlers at the destruction caused by unrestricted fishing in the North Sea ; and the Government was frequently and persistently urged to introduce legislation to remedy the mischief. With the opening up of profitable ventures in remoter regions, the outcry of the trawlers died away, and the tales of pitiful distress were hushed for the time being. Signs are, however, not wanting that the unrestricted fishing of the virgin grounds of the distant regions is producing its inevitable effect, and we may hear much more in the future of trade crises.

It is difficult to fix the time when the complaint of overfishing in the North Sea was first reasonably put forward. The Royal Commission on Irish Fisheries of 1837 and the Royal Commission on Herring Trawling (Scotland) 1863, are not relevant in this connection. In 1863 the attention of Parliament was directed to the condition of the Sea Fisheries, and in that year a Royal Commission was appointed to inquire whether or not the value of the fisheries was increasing, stationary or decreasing ; whether or not the existing methods of fishing caused permanent injury to the fishing grounds, and whether an extension of existing legislation was necessary. There were then practically no steam trawlers in the North Sea or anywhere else, and probably the maximum number of fishing smacks engaged in trawling in that area did not exceed 700. The Commissioners found, in our opinion rightly, that trawling in the open sea was not wastefully destructive, and required no legislative interference, for, if any ground were overfished the fishing there would become unprofitable, and the trawlers would go elsewhere.

The Buckland-Walpole Commission was appointed in 1878. Before this Commission, as before that of 1863, allegations of the destructiveness of trawling were made, but it should be noted that they were again made by non-trawlers. The chief point they endeavoured to establish was that the trawl destroyed the eggs or

spawn of sea fish, which was universally thought by the fishermen of those days to develop at the bottom of the sea where the trawl is worked The details of the evidence given before, and the conclusions reached by this Commission are now of historical importance only, and must be looked for in the original blue-books One thing, however, ought to be noted, the Commission of 1878 recommended that power should be given to the Secretary of State to forbid trawling in any territorial waters The Commission of 1878 had little effect on subsequent legislation, and the next Royal Commission on trawling was appointed in 1883 " to inquire and report on the complaints that have been made by line and drift net fishermen of injuries sustained by them in their calling, owing to the use of the trawl net and beam-trawl in the territorial waters of the United Kingdom " By this time conditions had altered considerably, we now find the trawlers themselves raising their voices against the excessive employment of their own method of fishing

The Commissioners engaged Professor W C McIntosh to make a series of observations on the effects of trawling on Scottish and English steam trawling vessels, and his report, published as an Appendix to the report of the Commissioners, is still a document of considerable interest

The trawlers of Hull and Grimsby who gave evidence, stated that the number of flat-fish, particularly soles, had diminished, that the nearer grounds were impoverished, and that they had to go greater distances for fish

The assertion that trawling destroyed the spawn of fish was again put forward, by liners and drift netters, but it was now proved conclusively that such was not the case That trawling might in certain circumstances cause impoverishment of fishing grounds was now for the first time recognised officially The Commissioners found that on many fishing grounds, from the Moray Firth to Grimsby, there had been a falling-off in the take of flat-fish, both as regards quantity and quality There had also been a decrease in the takes of haddock in certain places, chiefly in bays and estuaries

With the exception of soles, no decrease in the quantity of sea fish was demonstrated to have taken place on the offshore fishing grounds of the North Sea The Commissioners, therefore, in their report (1885), recommended that the Scottish Fishery Board should have statutory powers given them to regulate or suspend trawling, or any other method of fishing within the territorial waters In the same year the Sea Fisheries (Scotland) Amendment Act was passed (48 and 49 Vict, c 70) This Act authorised the Fishery Board when they " are satisfied that any mode of fishing in any

part of the sea adjoining Scotland, and within the exclusive fishery limits of the British Islands, is injurious to any kind of sea fishing within that part, or where it appears to the Fishery Board desirable to make experiments or observations with a view of ascertaining whether any particular mode of fishing is injurious, or for the purposes of fish culture or experiments in fish culture, the Fishery Board may make by-laws for restricting or prohibiting any method of fishing for sea fish." The by-laws had to be confirmed by the Secretary of State for Scotland before they became operative. The Board soon took advantage of these increased powers; in 1886 they commenced closing the waters under their control against all methods of trawling.

About this time an enormous increase of steam trawling took place; this speedily provoking a plea from the trawlers themselves for some regulation against unrestricted trawling. Some of the more pronounced and outspoken complaints deserve a passing attention, as they are of some value in indicating the effect of a *laissez-faire* policy, even when applied to fisheries in such an extensive area as the North Sea. In 1888 a Conference of the representatives of the trawl-fishing industry was held in London, at which the following resolution was carried: "That the Royal Commission on Trawling, 1885, having recommended that power should be given to the Fishery Authorities to regulate or suspend trawling, or any other mode of fishing within territorial waters, in cases in which it is expedient to do so, this Conference is of opinion that legislation should take place on the basis of that recommendation, with the object of increasing the supply of inshore fish, and this Conference, therefore, respectfully urges the Government to take early steps in Parliament to confer the necessary powers upon the English authorities."

In the next Conference (1889) the leaders of the trawling industry complained of the large and distressing diminution in the North Sea of soles, turbot, plaice and all other flat-fish. The future was viewed with alarm unless immediate steps were taken to prohibit the catching of immature flat-fish. Suggestions were put forward urging the Government to enter into negotiations with Continental Governments to establish an international law to prohibit the wilful catching of immature fish, both without and within the territorial limit. It was argued that the territorial limits as defined, are not sufficient for the protection of immature fish. The proposer of the principal resolution said, "If you were to say you will not fish within territorial limits, and allow large trawlers to fish close on the borders of those territorial limits, we should witness what we have been witnessing for a number of years—large masses of these fish brought to the shore which are perfectly valueless."

Another Conference of the leaders of the trawling industry was held at Hull in 1890, when the following self-denying ordinance was passed "That this Conference of the trawl fishing industry of the east coast, having realised the enormous loss which the trade has sustained year by year, through the wholesale capture and destruction of immature and inedible fish, resolves that the whole of the delegates here assembled for themselves individually and the companies, corporations fleets and associations they represent, agree to abstain during the coming summer from fishing on the grounds where the immature fish are generally caught in abundance That the fishing grounds or nurseries referred to in the foregoing resolution shall be defined as follows 'That part of the North Sea the eastern boundary of which is the German and Danish coasts, the western boundary, long 7°30', the northern boundary, lat 56°, the southern boundary, lat 53°50'' "

This resolution proposed to close an area off the German and Danish coasts of considerably over 5000 sq miles, 3600 sq miles being outside the 3 mile limit, an area approximately as extensive as the Moray Firth, against the closure of which some years ago the British steam trawler owners protested In default of legislation this ordinance naturally failed, and the grounds in question were never effectually closed to trawling In 1890 a further Conference was held in London to which representatives of certain foreign Governments were invited At this Conference it was resolved that "The National Sea Fisheries Protection Association be requested to formulate a set of questions with a view to obtaining scientific and statistical information in relation to undersized fish, and forward it to each delegate in order that he may submit it to his Government for adoption" But nothing further seems to have been done

In 1892 the trawlers society, which had adopted the ostentatious title quoted above again protested against over trawling, and they resolved "That in the opinion of this Conference all trawling should be illegal in the territorial waters, and that further restrictions be imposed for the purpose of protecting spawning beds and breeding grounds" They also agreed to ask the Government to enact a law to prohibit the sale of undersized flat fish in British markets The size limits proposed were, plaice and soles, 10 in, lemon soles, 11 in, and turbot and brill, 12 in In the following year (1893) the Government appointed a select committee of the House of Commons to inquire into the condition of the sea fisheries Before this Committee the trawlers were again emphatic as to the depletion of the North Sea fishing grounds caused by unrestricted fishing The various banks in this region had been fished out successively, and the steamers were beginning to make those

distant voyages to Iceland and the Bay of Biscay and elsewhere which have been such a remarkable feature of fishery development during the two last decades. Some of the trawlers advocated an extension of the 3-mile limit, and the prohibition of trawling within 10 miles of the shore. They were especially emphatic with regard to the eastern coasts of the North Sea, and in particular desired that large areas outside the territorial waters should be closed by an international arrangement. The prevention of the sale of immature flat-fish was also strongly advocated, as it has been on many subsequent occasions by many branches of the fishing industry. Since the discovery of the distant grounds, however, the urgency of the trawlers' demands under this heading has somewhat abated of late years. With respect to overfishing the Select Committee of 1893 stated: " When we turn to the great fishing grounds of the North Sea, from the evidence which has been given by all persons interested in the fisheries, whether trawlers, or linesmen, whether smack-owners or fishermen, whether scientific experts or statisticians, there seems to be no doubt that a considerable diminution has occurred among the more valuable classes of flat-fish, especially among soles and plaice, and that this diminution must be attributed to overfishing by trawlers in certain localities." With regard to the suggestion that there should be an international basis of co-operation for the protection of the inshore grounds, the Committee recommended that as the territorial limit of 3 miles is insufficient for fishery purposes, negotiations should be entered into with the Powers bordering on the North Sea for an extension of this limit for fishery purposes only.

The next step taken by the trawlers for the protection of the fisheries of the North Sea was the introduction of a bill in Parliament to prohibit the sale of specified classes of flat-fish below a certain size limit. A detailed account of the attempts to secure an Act for this purpose would alone require a volume of considerable dimensions. Certain grounds in the North Sea are known to be frequented for the most part by certain species of undersized flat-fish. Other fish occur sporadically, but not in sufficient numbers to render a voyage to these grounds remunerative, provided the undersized flat-fish were eliminated from the catch. It was argued by the trawlers that if this elimination could be secured by the prevention of the landing or sale of flat-fish below a certain size, then trawlers would cease to frequent these grounds which would thus, in effect, become closed. The enactment of a law forbidding the landing or sale of flat-fish below a certain limit of size was suggested to the Select Committee of 1893. Two limits of size were proposed for such an enactment; one by the National Sea Fisheries

Protection Association, which is, for brill, 12 in, for lemon soles, 11 in, for plaice and soles, 10 in; and for turbot, 12 in The second suggested limit of size was that of the Marine Biological Association, based on the sizes at which the various species come to sexual maturity, namely 17 in for plaice, 12 in for soles, 18 in for turbot, 15 in for brill and 12 in for lemon soles These experts did not, however, recommend the adoption of quite so high a limit as that of sexual maturity The Committee rejected both these suggestions as impracticable, and proposed a smaller limit approximating to that then in force in certain foreign countries, namely 8 in for soles, plaice, turbot and brill

The next step of importance in this connection was the Bill of 1900, which was referred to a Select Committee of the House of Commons The evidence given before the Committee again revealed a marked difference of opinion on the question of a suitable size limit, between the witnesses who appeared on behalf of the trade and some of the scientific experts The Committee's report, published in July, 1900, gave rise to an acrimonious correspondence in the *Times* respecting the value of some of the scientific evidence Put briefly, the attitude of the trade was in favour of a size limit which would in their opinion be sufficient to prevent trawling on the grounds in question, in the case of plaice, the most important fish concerned, this limit was 8 in For soles the limit was also to be 8, and for turbot and brill, 10 in The Committee thought it was proved beyond doubt that there was a very serious diminution of the supply of certain kinds of flat-fish, particularly in the North Sea Of late years the total quantity of such fish caught had remained nearly stationary, a fact which, taken along with the enormously increased catching power, and the vastly larger area of sea subjected to fishing operations, seemed to show that the ancient fishing grounds were much depleted The whole of the local evidence, differing in many other respects, was practically unanimous on this point The Committee thought the evil a growing one, and that in default of a remedy the consequences to the fishing industry in the diminished supply of flat-fish would at no very distant future be disastrous They were of opinion that one of the causes of this diminution of the supply was undoubtedly the destruction of immature fish In their view no effort should be spared (1) to arrange for international treatment of the subject generally, and especially to regulate for the North Sea area, and (2) to provide for the equipment of the Government Departments in charge of the subject, so that they may effectually pursue scientific investigations

Owing, however, to the fact that an important witness repre-

senting the Marine Biological Association was of opinion that if the size limit given in the Bill were adopted, the Bill would be of no practical use, and that it would only be effective if the size limit were increased to 13 in. for plaice, the Committee felt that it would not be expedient to pass the Bill into law without further inquiry and investigation. In spite of this rebuff the trawlers did not relax their efforts, and in 1904 another Bill was introduced, this time in the House of Lords. It differed from the preceding one in that it was an enabling Bill; that is, it proposed to confer on the Central Authority for fisheries power to make orders to prohibit the landing of fish of kinds and sizes to be specified, in such localities as might be found necessary. A select Committee of the House of Lords sat during February and March, 1904, when evidence was again taken both from witnesses representing the trade and from scientific experts. The various departments in England, Scotland and Ireland concerned with the administration of the fisheries were also represented. The evidence given by the trawlers was much the same as before, but the scientific witnesses, or at any rate some of them, had by this time considerably modified their views. The witness on whose evidence the Bill of 1900 was thrown out, now maintained that there are two races of plaice in the North Sea. "The northern area where steam trawlers fish is inhabited by a larger race of plaice, maturing at a different size from those in the southern area, which, I believe, is inhabited by a smaller race of plaice. It so happens that the two races correspond with the areas occupied by the smacks and steam trawlers respectively."

This is, indeed, a most remarkable coincidence!

From this theory the witness proceeded to support two size limits, one for the ports frequented by the steam trawlers, and another for those frequented by the smacks. As to the impoverishment of the fishing grounds, the position taken up in 1900 is definitely abandoned, and nothing further is said about the 13 in. size limit for plaice. The evidence now given is, "Some few years ago I tried to put together the statistical evidence on this point, and I submitted it to the Committee of 1900. In that paper I showed for a large number of different fisheries that the complaint of the fishermen was correct, that the average catches per boat had been declining for a continuous series of years. But it has been pointed out by certain critics that to conclude from that evidence that the abundance of fish in the sea is less now than was formerly the case is a logical fallacy. I have accepted the criticism that it is impossible, merely from the evidence of the decline in the average catch of the fishermen with an increasing number of boats, to conclude that there has been an impoverishment of the grounds.

I am therefore not prepared to offer evidence at the present stage as to what size limits are desirable

The Select Committee expressed their opinion that the proper way to protect the fishing grounds in the North Sea was by an international agreement between all the powers concerned

The Bill passed the House of Lords but was rejected by the Commons Since the report of the Committee of 1904 statistical evidence has been accumulated which throws light on the North Sea fishing grounds and also on the relative value of the newly discovered grounds as compared with the old favourite The official statistics published by the Board of Agriculture and Fisheries show that while the quantity of demersal fish landed in England and Wales from beyond the North Sea has increased enormously until 1911 that taken from the North Sea itself has declined —

WEIGHT IN TONS OF DEMERSAL FISH LANDED IN ENGLAND AND WALES

	1903	1904	1905	1906	1907	1908
North Sea	260 313	230 975	207 440	217 572	220 609	204 008
Beyond North Sea	67 625	78 216	93 395	203 863	224 380	228 175

	1909	1910	1911	1912	1913
North Sea	198 505	186 628	185 752	187 018	169 272
Beyond North Sea	241 214	241 106	252 118	250 470	248 765

In 1907 for the first time the demersal fish taken beyond the North Sea exceeded that taken in the North Sea itself in succeeding years this preponderance of the extra North Sea grounds has become more and more marked The value of the various fishing grounds from the purely utilitarian point of view of the director of a steam trawling company whose sole object is to provide his shareholders with as handsome a dividend as possible may be arrived at by another calculation The weight of fish caught per day s absence from port affords an estimate of this desirable feature of the fishing grounds A safer test of the productivity would be furnished by the yield per day s fishing but as the amount of fishing on a given ground is regulated not by philanthropic but by purely profit making considerations the strain that may be put in the future on any area may fairly be estimated in the above manner The table (see Appendix III p 276) shows the weight in cwts per day s absence from port of steam trawlers on the fishing grounds from 1906 to 1913 the whole period for which such figures are available

Trawler-owners and skippers know their business; they will not send their vessels on longer voyages to distant fishing grounds if shorter ones to nearer grounds would produce the same effect.

The northern grounds are undoubtedly richer or more prolific of fish life than the southern. Demersal fish are classified in the official statistics furnished by the Board of Agriculture and Fisheries, as coming from one of a number of different regions. The amount of potential trawling ground in these regions varies a great deal, and there is not much reason in contrasting one area with another; at any rate, the contrast or comparison should not be pushed too far. Several interesting facts are, nevertheless, apparent from a study of the table showing the quantity of demersal fish landed in England and Wales from the various fishing grounds from 1906 to 1913. The gradual decline in the productivity of the North Sea is noticeable. Twenty-five years ago, probably 90 per cent of the demersal fish was caught on these famous grounds. In 1904, the first year in which any attempt was made to distinguish the locality of origin, about two-thirds, i.e. 66 per cent of the demersal fish landed on the east coast was taken from the North Sea. In 1905 about 55 per cent represented the North Sea's share, and in 1913 this had still further diminished to 41½. Probably the yield of the North Sea will still further diminish until it reaches a point at which, with minor fluctuations, it will become stable.

It must not be forgotten that it is not only English steam trawlers which take toll of the North Sea. The Scottish steam trawler statistics, which are considered more especially in reference to plaice and haddock (see Chapter IV, pp. 64 and 92), must not be omitted from consideration. There are also the other nations bordering the North Sea, a reference to the destruction of plaice caused by German trawlers has already been made (p. 62). The market statistics for Ymuiden give one an insight into the results of the Dutch steam trawl fisheries in the North Sea. The landings of these vessels at Ymuiden were 3961 in 1911, 3583 in 1910, and 3403 in 1909. The percentage of landings of all steam fishing vessels, including liners and drifters, to total landings increased from 8 in 1900 to 37 in 1911, while the percentage of fish landed by them increased from 49 to 85·3. In 1911 fish was landed at Ymuiden from 111 steamers (mostly drifters), compared with twenty-eight in 1910. The Ymuiden fleet itself consisted of 142 vessels, of which ninety-four were steam trawlers, compared with seventy-nine in 1910. The landings of fish by trawlers was much increased in the few years ending 1911. In spite of this there has been a steady decline in the catch of fish by steam trawlers in the North Sea per voyage day from 1904 to 1911. In the former year the daily catch was 1075·2

kilo (21 cwt) in the latter year 862 1 (17 cwt) The preponderance of "small" and "extra small" plaice, and of "small medium" and "small" haddock is noticeable (See Appendix IV, p 277)

Formerly the northern grounds were only fished in summer, but with the launching of the magnificently seaworthy boats of the latest type, the steam trawlers visit the White Sea grounds all the year round That these voyages are not unremunerative may be judged from the fact that the steam trawler *Trier* arrived at Hull on Christmas Day, 1911, after a voyage to the White Sea, lasting twenty four days, and landed 1700 kits of plaice, which sold for £1403 The Icelandic grounds still show good results The steam trawler *Macfarlane*, towards the end of November, 1911, landed at Hull, after a voyage of sixteen days, no less than 1080 kits of plaice, realising £1104 [1]

[1] During the war (1914–18) much higher prices were obtained but they must be regarded as abnormal in view of the conditions then obtaining

CHAPTER VII

LEGISLATION AND THE SEA FISHERIES

IT is only proposed to treat of legislation which has for its object the preservation of the continuity of the supply of fish, and consequently regulations of a police nature dealing with such subjects as the sale or barter of intoxicants to fishermen on the high seas, or regulations to prevent breaches of the peace or damage to fishing gear between different classes of fishermen fishing in close proximity are omitted.

The subject of legislation for the protection of fish and the development of the fisheries, since the former if rationally secured involves the latter, is one which bristles with difficulties. Fish are for the most part captured on the high seas, beyond the small and not definitely determined limit which bounds the territorial waters; and consequently legislation, to be effective, must be of an international character. Within this ill-defined territorial limit the subjects of a given state have the exclusive right of fishing, and national legislation is, or should be, effective within this area. Unfortunately, the ratio between the territorial waters and those which may be called extra-territorial is a very small one; and, though restrictive legislation in the territorial area should be effective in securing the prosperity of the fisheries in the inshore waters, it is to be feared that, compared with the immense destruction caused by modern methods of steam fishing and particularly by steam trawling, purely national legislation will have little effect on the future of the fisheries.

Since fishery legislation falls naturally into either national or international categories, it is advisable to consider as far as possible each separately, and also exactly what area comprises the territorial waters within which the subjects of any given State have the exclusive right of fishing.

The term "territorial waters" is commonly applied to waters within a "3-mile limit" from the shore. That the latter term is erroneous, a very little study of the subject will prove. The history of the evolution of the idea of territorial waters and the modern practice of most civilised nations concerned with fishery rights

have been treated with great comprehensiveness by Wemyss Fulton Reference must, therefore, be made to this work by those desirous of obtaining the most complete and accurate account of the subject [1] The most that can be attempted here is to give a brief account of the more important conventions which have exercised or still exercise an influence over British sea fisheries Theories concerning the areas over which any given State has rights of jurisdiction in fishery matters have varied considerably from time to time, and it has even been urged by the representatives of certain Governments that the exclusive fishery rights differ at one and the same time in different parts of the world, according as the so called "rights" of their subjects or citizens were affected For instance, the United States claimed exclusive fishery rights over the whole of the Behring Sea, while claiming the narrowest limit possible in favour of her own subjects off the coasts of the British North American Colonies The United States' claim in the Behring Sea was principally in reference to the fur-seal fisheries, but the tribunal of arbitration to which the question was referred in Paris in 1893 decided by a majority of five to two that "the United States has not any right of protection or property in the fur seals frequenting the islands of the United States in Behring Sea, when such seals are found outside the ordinary 3 mile limit"

For practical purposes the International Conventions for the protection of the fisheries to which Great Britain is a party, and in which the territorial waters or the waters where each State has the exclusive right of fishery are defined, are as follows The Conventions of 1839 and 1867 with France, the Convention of 1882 with Germany, France, Belgium, Denmark and the Netherlands, and the Convention of 1901 with Denmark Broadly speaking, each of these Conventions was the outcome of disputes between the fishermen of the different countries as to the exact limits within which they had the exclusive right of fishing, so that, naturally, each convention defines the exclusive fishery limits as against the subjects of the other State or States signatory to the Convention In their definition of the territorial waters these conventions differ, though there is a general tendency to agreement on the main point

The first Convention in which the exclusive fishery area of the British and French coasts was defined was that of 1839 For some years previously French fishermen had complained bitterly against the English practice of dredging for oysters in the vicinity of the French coast, while large fleets of French fishing vessels from Calais Boulogne and Dieppe were in the habit of fishing off the coasts of Kent and Essex in many cases within half a league of the

[1] *The Sovereignty of the Seas* 1911

shore. In 1837 a Commission was appointed jointly by the French and English Governments to determine, firstly, the limits within which the subjects of the two countries should be allowed to fish for oysters between Jersey and the neighbouring coasts of France, and, secondly, "to define and regulate the limits within which the general right of fishery on all parts of the coasts of the two countries shall be exclusively reserved to the subjects of Great Britain and of France respectively." This general definition is the only one which need be considered here.

With the exceptions provided for in the Convention, which were drafted mainly with reference to oysters, it was decided that the subjects of Her Britannic Majesty and the King of the French shall enjoy the exclusive right of fishery within the distance of 3 miles from low-water mark along the whole extent of the coasts of the respective countries. It was also agreed that, as regards bays, the mouths of which do not exceed 10 miles in width, the 3-mile distance be measured from a straight line drawn from headland to headland. This Convention was embodied in an Act of Parliament (1843) which contained, in addition to the definition of the limits as above, a number of regulations affecting trawling and oyster fishing. The Act was far from stopping fishery disputes, and the Convention of 1867 followed. In this Convention the exclusive fishery limits were defined as before, and an Act of Parliament was passed (1868) enforcing regulations on British subjects. The reciprocal legislation in France necessary in order to make the Convention binding on French subjects was, however, not passed.

A joint Conference of the North Sea Powers was held at the Hague in 1881. It was attended by representatives of the British, French, Belgian, Dutch, Danish, Swedish and Norwegian, and German Governments. The object of this Conference was not so much to protect the fisheries as to protect the fishermen from one another, in short, to regulate the police of the fisheries in the North Sea outside territorial waters. Incidentally, the question of the territorial limits as regards fishing came up for consideration, and this seems to have given the Conference more trouble than any of the other questions before it. Ultimately the territorial limits were defined as follows :—

"The fishermen of each country shall enjoy the exclusive right of fishery within the distance of 3 miles from low-water mark along the whole extent of the coasts of their respective countries, as well as of the dependent islands and banks. As regards bays, the distance of 3 miles shall be measured from a straight line drawn across the bay, in the part nearest the entrance, at the first point where the width does not exceed 10 miles."

Sweden and Norway did not join the Convention, as they objected to the definition of the territorial waters

A most important departure from the definition of the previous Conventions is the inclusion of the "dependent islands and banks"

The Convention of 1901 between Great Britain and Denmark refers to the islands of Iceland and Faroe For some years previously British trawlers had been in the habit of fishing in these waters, and the islanders, whose living to a great extent depends on the prosperity of the fisheries, were naturally anxious to keep these foreign trawlers at a respectable distance from the coast The Convention contains a definition of the territorial waters within a certain area which includes Iceland and the Faroes "The subjects of His Majesty the King of Denmark shall enjoy the exclusive right of fishing within the distance of 3 miles from low-water mark, along the whole extent of the coasts of the said islands, as well as of the dependent islets, rocks and banks As regards bays, the distance of 3 miles shall be measured from a straight line drawn across the bay, in the part nearest the entrance, at the first point where the width does not exceed 10 miles" Islets and rocks are now included, an important difference, at any rate potentially

The idea of a 3 mile limit probably arose in the first instance from its being the extreme range of effective protection from the shore, i e the extreme range of cannon shot [1] It seems to have been adopted as the general limit for fishery purposes by most of the northern European nations, as a matter of compromise and expediency, not because it is the ideal for fishery purposes As will be noticed from the preceding account of the North Sea fishing grounds, such a definition affords no reasonable measure of protection to the flat-fish of that area

In many instances fisheries for sedentary creatures such as oysters or sponges are prosecuted on banks which extend beyond the limit of 3 miles from low water mark of the coasts In these cases special legislation is often effected

Omitting special cases, such as banks of oysters, the sponge fisheries and fur seals, where the 3 mile limit is admittedly inadequate for protective purposes, it can hardly be maintained that for general fishing purposes such a limit is the best suited to preserve the fisheries as a whole, and to keep the balance between the different classes of fishermen Steam fishing has undoubtedly been productive of much good The organisation of the means of capture, and the placing of the catch on the markets in a rapid and efficient manner by the use of steam has largely developed the consumption of fish in our great industrial centres

[1] For full details see Wemyss Fulton, *op cit*

But if this cheapening of an article of food for the mass of the people is to be accompanied by the impoverishment or disappearance of a section of our population, then the price paid may be too high, especially when that section comprises some of the best types of sturdy, daring and vigorous manhood to be met with in the world. Fortunately the existence of the two modes of fishing—deep sea and coastal—side by side are not incompatible; and, although the protection of the inshore waters undoubtedly in the first place benefits the inshore fishermen and the smacksmen, ultimately it has a bearing on the prosperity of the offshore fisheries, as the steam trawling fraternity were compelled to admit in the contentious period, 1893–1903. Fishing on a commercial scale is impossible in the great depths of the ocean, and consequently the trawling ground available is limited in extent, though undoubtedly sufficient for present requirements. If, as was the case at many centres, it was difficult in 1911 to get some species of fish (e.g. hake) in sufficient quantity to make steam trawling pay, what is likely to be the condition of affairs in another twenty-five or fifty years if the present reckless exploitation of the fishing grounds is allowed to continue?

The inadequacy of the 3-mile limit for fishery protection has been admitted by the British Government for Scotland and Ireland, but not for English or Welsh waters. Here a digression is necessary in order to explain the method of fishery administration and control in the three kingdoms. Scotland may be taken first, and this for several reasons. Fishing has for generations occupied, and even now occupies, a relatively greater importance in Scotland than in other parts of the British Isles. A Central Board of Fisheries has existed for a much longer period in Scotland than elsewhere; and, what is of even greater importance, this Board has all along been vigilant in the study of the necessities of the fishing industry, and eminently desirous of its welfare. In Scotland alone have fishery statistics been collected long and carefully enough to render an historical survey of the development of the fisheries of scientific value. For these reasons the administration of the Scottish sea fisheries deserves more than passing attention, whatever opinion one may hold as to the wisdom of the attempts made by the Fishery Board to preserve the inshore fisheries.

In 1808 the Act already referred to for the further encouragement and better regulation of the British White Herring Fishery established a Board of Commissioners which developed into the present Scottish Fishery Board. The old Board was dissolved in 1882, and the present Board constituted. The powers conferred on this Board have been gradually extended until, with the passing

of the Herring Fishery (Scotland) Act of 1889, large powers of closure of the territorial and extra-territorial waters to trawling were granted In this Act, trawling within 3 miles of low-water mark on any part of the coast of Scotland was prohibited (except in the Solway and Pentland Firths), and also within the waters specified in a Schedule annexed to the Act, the most important of which was the Firth of Clyde The Board was also empowered to close the Moray Firth, and this was done (partly) in 1890 In 1892 a new by-law closed to trawlers the whole of the Firth, an area of approximately 1480 sq miles

The closure of these large areas outside the ordinary territorial waters was effective so long as the fishing was confined to vessels flying the British flag But with the appearance of steam trawlers under a foreign flag complications set in Apparently the Fishery Board were perplexed, and the first foreigner, a Dane, was unmolested Later a German trawler was prevented from landing at Aberdeen fish caught in the Moray Firth From 1898 onwards, a varying number of foreign steam trawlers fished intermittently in the Firth Strangely enough some of these were Norwegians, a country which up to that time had not been known to possess steam trawlers It was soon ascertained that these pseudo Norwegians were owned and managed in Grimsby, but were registered in Norway with the object of evading a by-law passed in conformance with a British Act of Parliament These vessels fished also in the Firth of Clyde, making Fleetwood their headquarters, and for several years they fished with impunity, always provided they kept outside the 3-mile limit The author has observed these vessels in Fleetwood with the letters and numbers of their foreign port of registry on the funnel, bow and stern, while the original letters and numbers of their British port of registry had not been effaced from their lifebuoys and punts Ultimately the Fishery Board prosecuted the masters of these foreign vessels for fishing within the limits of the Moray and other Firths, even although they were far from the 3-mile limit It should be noted that the actual skipper of these Norwegian trawlers was almost invariably a British subject, the ostensible skipper (for the purposes of registration a Norwegian subject) usually occupying the humbler, if not less useful, position of cook Convictions were obtained, and one was appealed against as a test case In this instance the master was a Dane and had been convicted of fishing at a point within the Moray Firth, about 4 miles from Lossiemouth The appeal was dismissed and the conviction upheld by the High Court

This, however, did not prevent the pseudo-Norwegians from depleting the Firth Further cases were taken by the Fishery

Board and fines inflicted for illegal fishing, but for some reason or other these prosecutions were dropped. Eventually, in 1909, the Fishery Board succeeded in getting an Act of Parliament passed to prevent the landing or sale of fish within the United Kingdom from steamers which, within the two months prior to the landing or selling, had caught, or shipped, fish taken within the prohibited areas set out in the Act. These prohibited areas comprised the Moray Firth, the Firth of Clyde and the other extra-territorial waters of the coasts of Scotland and Ireland. The Grimsby-cum-Norway trawlers made several attempts to contravene the Act of Parliament, but the resolute attitude of the Customs officials soon convinced them that the game was not worth the candle. In effect, then, these extra-territorial waters are closed to British steam trawlers, and to foreign steam trawlers who desire to land fish at British ports. They are, however, open to foreign steam trawlers who intend to land the fish on the Continent.

The extent of fishing by foreign steam trawlers in the Moray Firth before and subsequent to the passing of the Trawling in Prohibited Areas Prevention Act, 1909, is shown in the following table, which gives particulars of the number of different foreign trawlers reported fishing in the Firth, and the number of separate occasions on which they were observed for the six years ending 19th October, 1913.

Nationality of Trawlers.	Before Act in operation.				After Act in operation.							
	1907–8		1907–8		1909–10.		1910–11.		1911–12.		1912–13.	
	Tr.	Oc.	Tr.	Oc.	Tr.	Oc.	Tr.	Oc.	Tr.	Oc.	Tr.	Oc.
ndinavian .	25	199	29	211	17	164	10	159	17	126	12	166
man .	1	2	1	1	5	12	16	33	28	55	15	21
tch .	2	2	6	8	7	15	11	15	10	24	13	29
gian .	8	27	10	19	9	26	3	6	5	18	6	16
nd Total .	36	230	46	239	38	217	40	213	60	223	46	232

The Act was aimed principally at the pseudo-Scandinavian trawlers, and the average number of these vessels observed at work during the four years subsequent to the Act, as compared with the average for the two preceding years has fallen from twenty-seven to fourteen, and the number of occasions on which they were observed from 205 to 154. The benefit which might have been expected to accrue from this reduction has been largely neutralised by the increasing extent to which trawlers of other nationalities have resorted to the Firth, in their case the number of individual vessels has increased from fourteen to thirty-two, and the number of occasions on which they were observed from twenty-nine to sixty-seven.

This redistribution of nationalities has probably been of some real benefit, because while the pseudo-Scandinavians worked in the Firth all the year round, the German, Dutch and Belgian trawlers confine their operations to a limited period in the spring when cod are abundant in the Firth, and since the cod is a fish whose abundance does not appear to be much affected by trawling, the diminished fishing operations in the Firth during the rest of the year cannot be otherwise than beneficial The only other Scottish area which was fished to any extent by foreign trawlers was the Firth of Clyde, and such trawling has practically ceased there since the passing of the Act of 1909

Here, then, we have a definite policy pursued over a long period of years by a body constituted by statute for the protection and development of the fisheries of Scotland The keynote of this policy is the insufficiency of the ordinary 3 mile limit with a 10 mile line across the bays for the protection of the sea fisheries This policy was endorsed by the trawlers themselves in the 1893–1903 period, when they were greatly concerned about the future of the North Sea, and it is only the discovery and the exploitation of distant fishing grounds which, by relieving the pressure on the North Sea itself, has induced them to drop their agitation

In Ireland the administration of the Acts relating to the sea fisheries is also entrusted to a central authority—the Department of Agriculture and Technical Instruction for Ireland This body has adopted a policy similar to that of the Scottish Fishery Board—a policy which has for its first axiom the inadequacy of the 3-mile limit Under the by-laws made by the Irish Department, steam trawling is prohibited for the most part, if not entirely, within the 3-mile limit off the Irish coast and in many wide extra territorial areas It ought not to pass unmentioned that in Scotland and even more in Ireland the steam trawling element does not form such an appreciable portion of the fishing industry as it does in England

For England and Wales the central authority is the Board of Agriculture and Fisheries whose powers, however, are much more limited than those of either the Scottish or the Irish Boards The Board itself is concerned with the collection of fishery statistics, and (in recent years) the conduct of England's share of the international investigations into the fisheries of the North and neighbouring Seas The administration of the coastal fisheries is in the hands of various district committees, who enforce by-laws after they have been approved by the Central Board There are about a dozen of these district committees, and they vary widely in their efficiency On the one hand there may be a large committee with

a superintendent and over thirty fishery officers, with a large policing steamer and an annual income of thousands of pounds; while, on the other hand, there are committees with one fishery officer and an income of £200 a year or less. Now it is obvious that however much a committee with an income of this kind may desire to protect or encourage the coastal fisheries, it is, for financial reasons alone, entirely helpless. The remedy is for the isolated committees to amalgamate, as they are empowered or authorised to do under the Sea Fisheries Regulation Act of 1888, so that three or, at the most, four large committees might be formed with the power and the means to carry out the regulations for the protection of the inshore fisheries.

As an example of a large committee one may quote the Lancashire and Western. Originally formed as a Committee for the County of Lancaster for the protection of the fisheries of that county, it has been extended gradually until it comprises a good part of the west coast, and is by far the largest fishery committee in the country. The Committee is constituted by an Order of the Board of Agriculture and Fisheries under the provisions of the Sea Fisheries Regulation Act of 1888. Its finances are provided by a local rate, limited to a maximum of one-sixteenth of a penny in the pound, and levied over an area, the rateable value of which is at present a little more than 34 million. The contributing authorities are the County Councils of Lancashire, Cheshire, Flint, Denbigh, Carnarvon, Anglesea, Merioneth and Cardigan, together with the County Boroughs of Barrow, Birkenhead, Blackburn, Blackpool, Bolton, Burnley, Bury, Chester, Liverpool, Manchester, Oldham, Preston, Rochdale, Salford, St. Helens, Southport, Stockport, Wallasey, Warrington and Wigan. All these bodies are represented on the Joint Committee which meets at Chester. The following Boards of Salmon Conservators are also represented: The Kent, Bela, Winster, Leven and Duddon; the Lune, Wyre, Keer and Cocker; the Ribble; the Dee; the Clwyd and Elwy; the Conway; the Seiont; the Dovey, Mawddach and Glaslyn; the Ayron; the Teify and the South Carnarvonshire Board. In addition the Board of Agriculture and Fisheries nominates a number of representatives of the fishing interests of the district so that the full Committee consists of no less than eighty-four members. The Joint Committee has jurisdiction over the territorial waters from Cumberland to Pembrokeshire, with a length of coast-line measured round the larger bays and estuaries, but not up the rivers of 441 statute miles. The income of the Committee for police work and scientific investigations into the sea fisheries is about £10,000 per annum. The Committee employ several scientists, who are stationed either at

the Fisheries Department of the University of Liverpool, or at the Marine Laboratory and Sea Fish Hatchery at Barrow-in-Furness A report is published annually summarising the investigations carried out in the Irish Sea The administrative staff consists of a superintendent and a number of fishery officers, who are stationed partly on shore or on sea-going vessels At present the Committee possesses a steamer, motor boat and several sailing cutters

In 1913 there were eleven local fishery committees in England and Wales The total income of these bodies from all sources amounted to £18,747, of which the Lancashire and Western claimed £10,536 Three committees had a total income of less than £300 a year In three other cases the total income was less than £500 In two cases the cost of prosecutions and law expenses generally was nil, in six other cases it was under £20 Under the heading of Purchase, maintenance or hire of vessels or boats we find that two Committees spent nothing, three others £20 or less

On a large committee the influence of a small but clamant section of inshore fishermen, desirous of legislation not really in the interest of the fisheries as a whole, but rather in the interest of a section, would be practically nil, whereas in a small committee it might be overwhelming

The district committees have the power to frame by laws, which, as above stated, only become operative when the sanction of the Central Board is obtained, for a sea fisheries district, comprising any part of the sea within which His Majesty's subjects have by international law the exclusive right of fishing, and since so far as "international law" defines an exclusive fishery area, it is one within the 3-mile limit, it follows that the powers of the district committees in England and Wales are less extensive than those of the Central Boards of Ireland and Scotland The principles which guide, or ought to guide, a fishery committee in framing by-laws may best be considered by taking those in force in the largest area controlled by such a committee—the Lancashire and Western The object of the by laws is to prevent the destruction of undersized and immature fish, and by preserving a sufficient number of adults of each species to secure a continuity of the supply The biological ideal would be to allow every individual fish the opportunity of spawning once, but this is impracticable Obviously, the best means theoretically would be to prevent the capture of fish below a certain size This method would be preferable to any other, since, firstly, there would be no object in catching fish below the legal minimum, and, secondly, there would be little or no

interference with the implements of fishing, providing the latter were not unduly destructive. There is no statutory power for the enforcement of a minimum size limit for sea fish, though there is for shellfish. For edible molluscs there may be a minimum size limit for removal from a fishery, but there is no limit of size for sale in the markets or elsewhere. In the case of crustacea, there is both a legal minimum for removal from a fishery and also for sale in the markets, though these two limits do not necessarily coincide, since the former is enacted by the district fishery committees, and may vary from district to district, or even be non-existent, whereas the latter is statutory and universal.

Another preventive method is the establishment of close seasons. For various reasons this is not practicable in the case of sea fish, but it is for molluscs and crustacea. In the case of molluscs there is a statutory close season for certain kinds of oysters ; there may be a close season in a fishery district for mussels or cockles. In the Lancashire and Western District there is a close season for mussels, but not for cockles or crustacea.

A third method of prevention is the prohibition of capture, or at any rate, of removal from a fishery of the adult females while engaged in reproduction. This method is adopted only in the case of shellfish like crabs and lobsters, the females of which during the spawning season carry their eggs under the " tail." In this condition the eggs appear like small berries, and the animal is spoken of as a " berried lobster " or " berried crab," as the case may be. It is illegal to remove either of these from a fishery in the Lancashire and Western District.

The sale of a berried crab is illegal (by statute), but not a berried lobster.

The fourth method of protection is the entire prohibition of destructive methods of fishing. This method is adopted in the Lancashire and Western District. Steam trawling and destructive methods, such as the use of a " murderer " or " gadger," are not allowed.

While the Scottish and Irish Central Departments have had a definite policy as to the protection of the fisheries, the Board of Agriculture and Fisheries, on the contrary, seem to have had no initiative of any kind. Both Scotland and Ireland have persistently endeavoured to prohibit steam trawling as far from the coast as is reasonably possible, a policy which the present writer believes will ultimately prove to be sound.

The Board of Agriculture and Fisheries in their annual report for 1905 (p. 9, *et seq.*), publish a chart of the fishing grounds, together with a table showing the area between the 3-mile limit and the

200-metre line (109 fathoms) The areas between the 3 mile limit and the 9-mile and 13-mile limits are also shown —

	Area (in nautical square miles) between 3 mile limit and		
	200 metre line (109 fathoms)	9 mile limit	13 mile limit
Region I —White Sea .	128,917	21,750	36 250
Region II —Baltic . .	134 891	27,270	46,260
Regions III & IV to XVIII —Western Europe including Iceland, Faroe and Morocco .	447,761	81,130	135,150

Apparently the Board assume that the 200-metre line is the limit of practicable fishing, on this assumption they state that a 9 mile limit or a 13-mile limit would reduce the area available for trawling (excluding the White and Baltic Seas) by one fifth and one-third respectively In the latter case over 135 000 nautical square miles, i e an area nearly equivalent to that of the North Sea would be cut off from the trawlable area

The limit of 13 miles was contemplated in Section 10 of the Sea Fisheries Regulation (Scotland) Act of 1895

If the North Sea be considered apart from the other areas, it is found that between the 3-mile line and the 9-mile limit, there is an area of 12,000 sq miles, or 7 4 per cent of the whole extra-territorial waters , between the 3 and the 13 mile limit the area would be about 20,000 sq miles, or 12 3 per cent

There is nothing unreasonable or alarming in suggesting either of these limits for the North Sea, more especially when the latter limit (13 miles) would close for the most part grounds frequented by undersized fish To be effective such a closure must obviously be international The closure of the inshore areas would naturally be to steam trawling only, and a large area of fishing ground would thus be available for the inshore fishermen Under such an arrangement it is difficult to see how British fishermen could lose much, since the proportion of waters within which they would have the exclusive right of fishery would be greater than that of any other State

Another proposal which has been considered by the trawler owners as likely to prevent the undue depletion of the fishing grounds is the regulation of catching power At a Conference of representatives of the National Sea Fisheries Protection Association, held at Grimsby in 1902, it was proposed " That this Conference regards as conclusive the evidence of a widespread diminution of the supply

of food fishes in the North Sea and adjacent grounds, and is of opinion that the only practicable remedies are :—

(1) and (2) refer to the prevention of landing and sale of undersized fish, and the transplantation of young fish.

(3) The systematic regulation of the catching power during certain months of the year to prevent the capture of enormous quantities of fish that yield neither profit to the vessel, the crew, nor the vendor."

It appears the Tyne Steam Fishing Boat Owners Association of North Shields advocated that each year during June, July and August—the herring, salmon, mackerel and trout season—British steam trawler and line-boat owners should bind themselves to lay up one-third of their craft each month. It was pointed out that in addition to restricting the catch of fish at a time of the year when remunerative sales are not always possible, it would give the skippers and men the opportunity of enjoying a well-earned holiday, and also permit of the overhaul, survey and refitting of the vessels. After an interesting debate the resolution was carried by forty-seven votes to fourteen. There are, however, obvious difficulties in carrying out any scheme of this kind, and the idea does not appear to have been carried any further.

There is finally the alternative of keeping the territorial limits as defined by the present conventions, with an extension of the Scottish practice of closing arms of the sea which are definitely bounded by the territory of a single country. By the old common law of England, bays of which one shore could reasonably be discerned from the other shore were considered to be *inter fauces terrae*, and offences committed thereon were tried at common law. From many points of view there is much to be said for the adaptation of this idea to fishery purposes. Most of our inshore areas, such as Cardigan Bay or the Bristol Channel, have trawling grounds which are demonstrably capable of being exhausted in a very short time by the depredations of steam trawlers. The task of policing an area bounded by a straight line drawn between two definite and conspicuous objects (preferably lighthouses or lightships which would be visible by night), would be much simpler than the present work of patrolling a sinuous line following the coast at varying intervals from prominent landmarks. In actual practice the present territorial limit is, as regards England and Wales, at any rate, either not policed at all, or policed under considerable difficulties. Steam trawlers fish with impunity right up to the limit line, and often, if there is any relaxation of vigilance on the part of the fishery officers, cross the line in order to make a profitable haul. The local Petty Sessional Benches are loath to convict in

cases of infringement of the by-laws when the encroachment has been slight Steam trawlers are capable of moving, with the trawl down, at the rate of 5 miles an hour or more; and consequently, since the police vessels are well known and are visible at some distance, it is difficult to overtake them before they have slipped outside the limits into the open sea It follows that in many cases, though the fishery officers are certain that the law has been infringed, proceedings cannot be taken to bring the trawlers into court owing to the difficulty of furnishing legal proof of the exact spot where the breach of the law occurred If similar powers to those possessed by the Scottish and Irish authorities were granted to the English and Welsh fishery authorities, then inshore areas, even though they were beyond the "3-mile limit," could be subject to regulation in the interests of the sea fisheries as a whole To take an example, the present area of the Lancashire and Western District, which extends from Haverigg Point, in the County of Cumberland, to Cemmaes Head, in Pembrokeshire, is 1300 square geographical miles To extend the limits of the district in Carnarvon Bay to include all that portion of the sea within a line drawn from the South Stack Lighthouse (near Holyhead) to the lighthouse on Bardsea Island, would add approximately 101 square geographical miles to the present area of the district Similarly to extend the limits in Cardigan Bay to include all that portion of the sea within a line drawn from Bardsea Island Lighthouse to the Northern extremity of Cemmaes Head, in the County of Pembroke, the present southern extremity of the district, would add approximately 497 square geographical miles to its area If a line be drawn from Point Lynus, in the county of Anglesea, to the Liverpool North-West Lightship and from thence to the Liverpool Bar Lightship, an area of approximately 176 square geographical miles would be added to the district If another line were drawn from Walney Island Lighthouse, in the county of Lancaster, to Morecambe Bay Lightship and so to the Liverpool Bar Lightship, an area of 294 square geographical miles would be added to the district The jurisdiction of the local fisheries committee might, therefore, be extended as follows —

Present area	1,300	Square	miles
Added areas—			
Cardigan Bay	497	,,	,,
Carnarvon Bay	101	,,	,,
North Wales Coast	176	,,	,,
Lancashire Coast	294	,,	,,
	2 368		

The Irish Sea contains about 15 700 sq miles, so that even if

the above extensions of the fishery district were made there would still remain an area of over 13,000 sq. miles for unrestricted fishing. If the local by-laws are reasonable and have produced any effect in preserving the continuity of the supply of fish in the district, then it would be sound policy to advocate their extension over a wider area. The effect on the different classes of fishermen would be that the steam trawler would lose an additional 1000 sq. miles of potential trawling ground. Over a similar area the deep-sea fishing smacks would be compelled to use a trawl net, the meshes of which must be not less than 6 in. measured round the four sides of the square. The inshore fishermen using second-class boats would not be much affected. Only occasionally, and then mainly in the summer as at Morecambe, Fleetwood, Southport and Pwllheli, do these men fish outside the present territorial limits, i.e. in an unrestricted manner. The limited number of occasions they fish outside the territorial waters hardly makes it worth their while to carry special nets with small mesh, nets which would be illegal inside the district, so that practically speaking, and subject to certain limited exceptions, these men always fish under restriction. There would be, therefore, no change for them in any proposed extension. Steam trawler owners and skippers may be inclined to be scornful at any attempt made to extend the jurisdiction of the present district committees. Assuming the proposals outlined above for the Irish Sea ever came into force, it would practically mean that steam trawling in that area would be prevented within the 20-fathom line, which follows closely the proposed extended limits. Any fishing done by steamers within that line is almost invariably carried on by old and obsolete steamers which would be better scrapped. Moreover, since all well-managed steam trawler companies set aside annually certain sums to a reserve for depreciation, there is no strong reason against setting aside certain grounds, especially when such grounds are known to be frequented by undersized fish, and are in any case only fished by vessels in their decrepitude.

CHAPTER VIII

THE INSHORE FISHERIES

FOR many years the condition of the inshore fisheries and fishermen has been the special concern of the Central Authorities in Scotland and Ireland

In England and Wales the first attempt to legislate for the inshore fisheries was the passing of the Sea Fisheries Regulation Act of 1888 The destruction of immature fish and the decline of the inshore fisheries had been noticed for some years prior to this, and in particular evidence may be found in the report of the Buckland-Walpole Commission of 1879 The Local Government Act of 1888 had set up local administrative machinery which was utilised for the regulation of the Sea Fisheries The Act of 1888 authorised the Board of Trade[1] on the application of a county or borough council, to create a sea fisheries district comprising any part of the sea within which His Majesty's subjects have by international law the exclusive right of fishing, together with the adjacent sea coast, and to provide for the constitution of a local fisheries committee for the regulation of the sea fisheries within such district The powers, duties and responsibilities of these committees are dealt with elsewhere, and it now remains to estimate the value of their work for the preservation of the inshore fisheries

In judging the work of these committees it is only fair to point out that the framers of the Act of 1888 and the Acts amending it (those of 1891 and 1894), were very imperfectly acquainted with the then condition of the sea fisheries, with the causes of deterioration and the necessary remedies No accurate knowledge of the life histories and habits of local species of fish was available, and the conditions under which the fisheries were carried on were, for the most part, unknown either to the Central Department or the local authorities concerned in fishery administration

The consequence was that a whole catalogue of hasty and ill-considered legislation was forced on the inshore fisherman, and it is to be feared that in too many instances, instead of assisting the

[1] These powers have now been transferred to the Board of Agriculture and Fisheries by 3 Edw 7 1903.

development of the inshore fisheries, this legislation merely accelerated the decline which had set in. In fact, had all the local by-laws been carried out rigidly, the state of affairs would have been intolerable.

As a matter of fact, for various reasons, much of the local regulation was ineffective. Many of the committees were ill-supplied with funds, and this limited to a very large extent their power of harassing the inshore fishermen. In other cases the regulations were so obviously unfair and unreasonable that—after a little preliminary agitation—no attempt was made to carry them out in their entirety, and the practice of granting " concessions " was forced on the committees. These concessions were purely illegal, the proper procedure being to repeal a harsh by-law; but as this often involved considerable expense and a great waste of time the local committees found it easier and just as effective to instruct their officials to take no steps to prosecute offenders in certain cases of breaches of the more obnoxious by-laws. Thus one finds that for years bodies appointed to enforce certain regulations were, in fact, doing their utmost to connive at breaches of them.

The whole procedure of these local committees was for a considerable time—and in some instances still is—open to very serious criticism;[1] in not a few instances an impasse was created.

The authorities contributing to the finances of the committees in some cases declined to pay the sums due from them to the committee, but after trial in the High Court,[2] it was decided that as long as the Fishery Committee existed, and the Order establishing it was in force, no contributory authority could legally decline to pay the amounts due from it under the Order. The proper method of procedure is to appeal to the Central Authority for a dissolution of the Order.

In 1913 the President of the Board of Agriculture and Fisheries appointed a Committee to " inquire into the present condition of the inshore fisheries, and to advise the Board as to steps which could with advantage be taken for their improvement and development." It is particularly unfortunate that the constitution of this Committee was such as to invite criticism, and it is even more unfortunate that its recommendations are of such a sweeping nature as to render them practically impossible of adoption—at any rate, for a generation. It is a matter for regret that the report of this

[1] Some of this criticism was quite fair, some unfair. See, *The Lancashire Sea Fisheries*, by C. L. Jackson. Manchester, 1899. *The Devon Sea Fisheries.* " The Opening of the Bays to Trawlers," by Stuart A. Moore. Privately printed. Smardon, Brixham, 1904, and the evidence given before the Committee on Fishery Investigations, 1908, p. 305, *et seq.*

[2] See, " Reg. *v.* North Riding of Yorkshire County Council" (1899), 1. Q.B. 201.

Committee was expressed in language likely to arouse the most determined opposition from the authorities interested in maintaining the *status quo*, more especially since it should have been possible to frame reasonable recommendations for the improvement of the administration of the inshore fisheries As it is, nothing short of a Napoleonic effort on the part of the Central Department is likely to give effect to the recommendations of Mr Runciman's Committee, whether the Board possess a Napoleon remains to be seen A detailed consideration of the report of this Committee, which was published early in 1914, is essential to a correct appreciation of the present position

The Departmental Committee on Inshore Fisheries held their first meeting in February, 1913 Their report was issued in May, 1914 The condition of the industry all round the coast was investigated, with the exception of the counties of Devon and Cornwall, which had been previously dealt with by a special Committee [1] The subject was approached from the point of view of the inshore fisherman, who is defined as one "who goes out either for a day or a night's fishing, he usually fishes from his own boat, which is generally one of limited dimensions and without steam power, fishing within sight of land, although not necessarily of home, and he also carries on those fisheries which do not in all cases require the use of a boat, such as fishing with stake nets and the gathering of shellfish by hand" The Committee point out that many fishermen who clearly come within the description of inshore fishermen are sometimes engaged in fishing beyond the territorial limits

The Committee met on seventeen occasions to take formal evidence Three sub-committees were also formed for the purpose of local inspection of the three coasts In one respect there will be general agreement with the findings of the Committee, and that is with regard to the claims of the inshore fisherman "We consider that the continued existence of a hardy race of inshore fishermen is of importance to a great maritime nation and a great naval power We find that the Royal National Lifeboat Institution looks mainly, if not entirely, to the inshore fishermen to man its boats"

The working of the rocket life-saving apparatus to a great extent depends on the services of the inshore fisherman In quite a large number of ports and stations a considerable proportion of the Royal Naval Reserve recruits are drawn from the ranks of these men The inshore fisherman has also an inherent aptitude for the sea and ships "In these circumstances we have no hesitation in

[1] Report of the Committee appointed to consider applications of the Devon and Cornwall Local Fisheries Committees for grants from the Development Fund for assisting fishermen to instal motor power in their boats and for other purposes Cd 7200 1913

saying that every endeavour should be made to arrest the falling off in the numbers of this class of men." The Committee consider that it would be an impossible task to recreate such communities of inshore fishermen as at present exist, if once they were allowed to disappear. At the outset a difficulty was met with. It was impossible to arrive at any authoritative conclusion as to the exact produce of the inshore fisheries as distinct from the deep-sea fisheries, and as to the number of boats and men engaged in them at the present time compared with ten years ago. This is to be attributed to the faulty method of collecting statistics adopted by the Central Authority. The general trend of the evidence, however, was to the effect that, while in some parts of the coast the industry is fairly holding its own, in many places there is distinct evidence of decline. The Committee give specific instances of difficulties under which inshore fishermen labour. In the case of Church Ope, Portland Bill and King's Lynn, these refer to insufficient and inadequate landing and berthing facilities, and as there is a distinct tendency subsequently in the report to blame the local fishery committees for all the evils under which the inshore fisherman suffers, it may be permissible to point out that the remedy in the specific cases mentioned above was in the hands of the Central Authority.

Having regard to the difficulties under which the inshore fisherman plies his calling, the Committee are surprised that the general condition is not worse than it is. The decline is attributed by the fishermen to a number of causes. The chief complaints made were: (1) The falling off in the quantities of fish. (2) The operations of steam trawlers. (3) The destruction of undersized fish. (4) Depredations by sea birds. (5) Inadequate prices obtained for the fish. (6) Excessive railway rates. (7) The discharge of sewage. (8) Complaints of one class of fisherman against another.

The Committee deal with these and other complaints in some detail, but owing to the lack of expert knowledge on the part of the members of the Committee such treatment is inadequate and unconvincing. The complaint as to there being less fish caught now than formerly is of very long standing, and throughout the inquiry the complaint was constantly reiterated, though unfortunately it cannot be subjected to the test of figures. The Committee report, " The system adopted by the Central Department for the collection of statistics . . . does not provide sufficient discrimination."

The paramount reason adduced by fishermen for the relative poverty of their catches was depletion due to steam trawling. The Committee state, " The complaint was as vehement as it was universal."

Whether or not these disappearances of certain species are permanent or periodical, there is no doubt that the inshore fisherman is now driven out of areas beyond the 3-mile limit in which he was formerly undisturbed, and there are, therefore, less fish accessible to his operations Steam trawling has made it either unprofitable or, as in the case of crabbing, impossible for him any longer to fish these grounds In many parts of the coast there was a unanimous feeling that the only effective remedy in the interests of the inshore fisherman was to extend the limits of territorial waters (various limits being suggested from 4 to 15 miles)

This question of maintaining a supply of fish for the inshore fisherman to catch is so obviously the most important the Committee had to consider that it is a matter for surprise, even in a Committee constituted as this was, that they should dismiss the subject with very trivial remarks It is useless to propose palliative measures such as co-operation and mutual insurance societies if this, the root problem of the whole question of the future of the inshore fisheries, be either ignored or lightly dismissed The Committee recognise that other questions beyond the mere extension of the limits in any particular locality are involved, and these questions are —

1 The increased difficulty which might be experienced by fishermen in ascertaining whether they were within or without territorial limits if at a greater distance than 3 miles from the coast From this statement one would conclude that the present limit line is drawn " 3 miles from the coast " Nothing could be further from the truth As the Committee themselves note, but evidently fail to realise, on the following page of the report (xvi), the distance is 3 miles from low-water mark Consequently it is only in the case of cliffs which dip abruptly into the sea that the limit is exactly 3 miles from the coast This is quite exceptional In the vast majority of places the tide ebbs to a greater or less distance, and in some cases for from 7 to 10 miles, and consequently the present limit line is more often than not drawn at a considerably greater distance than 3 miles from the visible coast To argue that a skipper of a steamer —who is supposed to have passed a Board of Trade examination in navigation and seamanship—is incapable of taking accurate cross-bearings when his distance from the coast is more than 3 miles implies a lack of ability to understand the subject which can only be described as lamentable As a matter of fact a 60 mile limit is in effective operation in the case of pelagic sealing around the Pribilov Islands, so the objection of the Committee may be dismissed as trivial and irrelevant

The second difficulty put forward by the Committee is that of

policing a larger area than at present exists. This difficulty would be more apparent than real. A 3-mile limit would be less sinuous and less difficult to police than a 1-mile limit; similarly a 6-mile limit than a 3-mile line. As a general rule illegal steam trawling goes on in fairly close proximity to the limit line, and only far within it in exceptional cases, since the risk of capture and punishment is greatly increased in the latter case. Consequently it is not the area—as the Committee seem to think—which requires policing, but the line across which the steam trawlers have to escape in order to fish with impunity. The task of preventing smuggling does not increase with the size of the country, but rather with the length of the frontier. And in the case of the fisheries a 6-mile limit, to take an example, would actually be shorter than a 3-mile limit line. The difficulty would be almost entirely eliminated if straight lines were drawn from headland to headland across our bays. These headlands are usually furnished with lighthouses, so the task of policing at night would be facilitated.

The third difficulty stated by the Committee is "Whether the fishing industry of this country as a whole would gain more by an enlarged territorial area than it might lose by its operations being restricted off the coasts of other countries, which would claim a correspondingly enlarged area of territorial waters." The Committee go on to say, "From the point of view of the inshore fishermen, apart from all other considerations, it seems obvious that it would be to their advantage to have a larger area of territorial water to themselves; but in view of the international questions involved, and the fact that the matter is at the present time under the consideration of an Inter-Departmental Committee on Fisheries, we make no recommendation on that point."

In the first place this statement should be qualified. The expression "it would be to their advantage to have a larger area of territorial water reserved to themselves" does not mean that the inshore fisherman is allowed to do as he pleases. Inshore trawling is subject to regulation as to the size of the meshes of the net which may be used, and there are other regulations which need not be exactly specified. These regulations have for their object the prevention of the destruction of undersized fish. It is a comparatively easy matter to enforce these regulations. The other point raised is undoubtedly a most important one, and it is a pity the Committee did not consider it carefully.

The Committee continue, "It would perhaps be safe to say that almost every witness who appeared before us referred to the wholesale destruction of undersized fish, especially young flat-fish." The recommendation made on this point is one that might have

been anticipated It is to this effect, "We accordingly recommend legislation enabling the Central Department to make Orders for the prevention of the sale, marketing or exposure for sale of undersized fish, subject to such exceptions and conditions as may be prescribed for that purpose"

This subject of the destruction of undersized fish has been dealt with elsewhere (Chap IV), and the arguments put forward then should be considered before these recommendations are adopted

The Committee then proceed to deal with other complaints, all of which, though of some importance, are subsidiary to the great one of maintaining the future supply of fish on the inshore grounds

The administrative duties of the Central Department and the Local Fisheries Committees next occupied the attention of the Departmental Committee, who sum up in a manner very adverse to the local bodies "The evidence which has been laid before us in the committee-room, and the impression which has been left on our minds as the result of our local tours, convince us that there are grave weaknesses in the constitution of the Local Fisheries Committees The primary object for which they were constituted, namely, the protection and development of the inshore fisheries, has not been achieved" One objection urged against the local bodies is that the contributing authorities may be more interested in keeping down the contributions than in developing the fisheries No doubt this is a charge which may be brought against all local authorities, for instance, education and public health committees, but it is obviously not in itself a sufficient reason for dissolving the whole of such authorities because a few are recalcitrant The Departmental Committee point out that the cost of inshore fishery administration falls entirely on maritime, county and borough councils, and that London, for example, though a great fish-consuming centre, contributes nothing to the expenses This has, of course, long been recognised by the Local Fishery Committees, who have repeatedly urged the Central Department to introduce legislation to remove this anomaly

Under the provisions of the Sea Fisheries Regulation Act of 1888, the Central Department has convened annually since 1891 a meeting in London of representatives of the local committees for consultative purposes on matters relating to the Sea Fishery Regulation Acts There is hardly any subject of interest to the inshore fisherman which has not been discussed annually at these conferences for at least twenty years, but it would be very difficult to name one which has received any attention at the hands of the Central Department As early as the second conference (1892) the financial question was raised by the Western Committee, who

suggested "that the protection of our sea fisheries being a question closely affecting the United Kingdom generally, and not merely the counties and boroughs abutting on the sea, the expense of such protection should be defrayed by the Imperial Exchequer, and not by local sources." The attention of the Central Department has been drawn to this question practically every year since. As long ago as 1896 the clerk to the Western Committee stated "that so long as the individual county councils of the several districts have to bear the whole expenses for the maintenance of the staff and all the work, that the work cannot be efficiently done."

At first the Central Department were quite firm on this point, no financial assistance could be anticipated from the Imperial purse. But of late years, with the general development of grants in aid of local administration, there has been a decided change in the attitude of the Central Authority. The Committee on Fishery Investigations (1908) reported in favour of the State aid of local fishery authorities in the following terms: "It was urged that inasmuch as the improvement of fisheries was beneficial not only to the immediate localities, but also, in some measure at least, to the nation at large, it was not reasonable that the whole cost should fall upon the ratepayers of the maritime districts, but that a substantial contribution in aid of investigations having this object should be made from Imperial funds. The justice of this contention seems to have been recognised in Scotland and Ireland, where the funds available for the promotion of the local fisheries are not drawn exclusively from the coastal districts, and the Committee are of opinion that a similar principle should be recognised in England and Wales." Apart from some small grants to one or two of the larger committees from the Development Fund, funds which were only obtained in the face of strenuous opposition on the part of the Central Department, the position in 1919 is as it was in 1892, when the attention of the Board of Trade was first directed to it. The next complaint of the Departmental Committee is, "there does not appear to be any really effective intercommunication between the different committees, whether by correspondence or otherwise." Now this is obviously one of the duties of the Central Department; and the conference established by the Act of 1888 was designed to facilitate the work of the Board in this respect. The futility of this annual conference, which, it must be borne in mind, is controlled entirely by the Central Authority, was recognised as long ago as 1901 by the Lancashire and Western Local Fisheries Committee, who urged the appointment of a committee to draw up suggestions as to the best method of giving more practical usefulness to the annual meeting of representatives. The subject

was again raised by the Northumberland Committee in 1909 with the result that a special preliminary conference was held in 1910 Nothing effectual was done, and this annual conference is just as futile and ineffective in 1919 as it was in 1891

The Departmental Committee's next point is that the present system has failed in maintaining intimate relations between the fishermen and the fishery authority In particular, the absence of the "fishery members" from the meetings of the local committees is adversely commented on In conclusion, "the Local Fisheries Committees, as at present constituted, however satisfactory from a theoretical point of view, appear to suffer from drawbacks which the keenest interest and the most intelligent devotion of a few sympathetic members are not sufficient to overcome"

The Departmental Committee, therefore, recommend a large number of changes which may be summarised as follow —

1 A strengthening of the Central Department to an extent commensurate with the fishing interests under its charge, by raising its status in the Board of Agriculture and Fisheries from that of a branch to a position coequal with Agriculture, and by giving the head of the Fisheries Department the rank of a permanent secretary with direct access to the minister in charge of Agriculture and Fisheries

2 The exercise by the Central Department of the following administrative powers and duties, some of which have hitherto been in the hands of the Local Fisheries Committees —

(*a*) The making, repealing, simplification and enforcement of all sea fishery by laws and regulations

(*b*) The division of the sea coast of England and Wales into four or five convenient fishery districts, and the appointment in each of a resident local inspector directly responsible to the Central Department

(*c*) Wider powers of control and development of shellfish beds, together with enhanced powers for the purification of shellfish

(*d*) Intervention—legal or otherwise [*sic*]—where public fisheries or fishing rights are imperilled

(*e*) The collection and dissemination amongst fishermen of fishery intelligence

(*f*) The acquirement of certain of the powers hitherto exercised by other Government Departments in regard to fishery matters, such as the collection of statistics of the number of fishermen and fishing vessels

(*g*) The continuance, on an enlarged scale if possible, of the scientific work now carried out by Local Fisheries Committees as part of the general scientific work of the Department

As to funds, it is recommended that the cost of official fishery administration in England and Wales be a charge on national funds as in Scotland and Ireland, instead of partly on local authorities as at present ; and that the Central Department should be directly endowed with ample funds for all the purposes of fishery development recommended in the report, as well as for the proper enforcement of such by-laws as may be found necessary in view of the changes recommended. With this proposed enlargement of the powers of the Central Department there is a corresponding decrease in the powers of the local committees. In fact, the committees as at present constituted will be dissolved, and local advisory bodies substituted. The representatives of the contributing authorities would, like the authorities themselves, disappear on the new advisory bodies ; the members of which would be entirely nominated by the Central Department. It will easily be seen that what is proposed is the substitution of a bureaucratic system in the place of representation of the ratepayers.

The chief official witness of the Board of Agriculture and Fisheries suggested that that Board should take over the fisheries work performed by the Board of Trade, a suggestion which was adopted by the Departmental Committee; but the same witness when asked as to how many of the staff of the Board of Agriculture and Fisheries were conversant with the details of inshore fishing, replied to the effect that the Board were " shorthanded," and " we have not a full staff, and the existing officers have been so pressed with work that they have not been round the coast as much as their duties require." The fact is, that up to the present the Central Department has taken no interest whatever in the fate of the inshore fishermen.

During the progress of the war the Board of Agriculture and Fisheries commenced to put into force one of the Committee's recommendations. Six local resident inspectors and six assistant inspectors were appointed " to study and care for the interests of the fisheries, which involves multifarious activities that cannot be described in answer to a Parliamentary question."

Although the fisheries of Ireland are potentially of great value they do not appear to have been exploited by the local fishermen. It is said that in 1553 Philip II of Spain obtained a licence for his subjects to fish off the north coast of Ireland for the term of twenty-one years, paying an annual sum of £1000 for the privilege. In the reign of Elizabeth an Irish statute prohibited foreign vessels from fishing in Irish Seas without a licence. The cost of this licence was 13s. 4d. annually for 12-ton vessels. In the time of the Commonwealth Swedish vessels were permitted to fish off the Irish coast.

Attempts were made to develop the fisheries of Ireland in 1736, when the Nymph Bank off the coast of Waterford was discovered, and in 1802 when Fraser attempted to supply the London market with fish from this bank [1] The bounty system, which has already been described in the case of the herring fisheries of Scotland, was also tried in Ireland Space forbids an enumeration of the various steps taken to develop the Irish fisheries by means of bounties [2] From 1801 to 1819 the year in which the Commissioners of the Irish Fisheries were appointed, £113 898 were paid as bounties in Ireland on fishing boats, cured fish and fish oil

The Act of 1819 (59 Geo III, c 109), which provided for the appointment of the Commissioners, also made provision for a bounty system For vessels of 15 tons and upwards used in fishing or curing fish there was a bounty of £2 10s per ton, but not payable for any tonnage above 60 The first pound was payable on the return of each vessel, of the remaining £1 10s a bounty of 6s per barrel for herrings gutted with knives, 4s per barrel for herring, pilchard and mackerel not so gutted, and 4s per cwt for dried cod, ling, hake, haddock, glassen (*Gadus virens*) and conger There were also payable £3 per tun for every tun of oil from whales or other fish, £4 per cwt on whalebone, 3s per barrel for herring, pilchard and mackerel payable to persons residing in Ireland not entitled to the tonnage bounty, and 4s per cwt for dried cod, ling, hake, haddock, glassen and conger Modifications were introduced in 1820, 1824 and 1826, but it is unnecessary to specify these [3] The framers of these Acts were doubtless influenced by the success of the bounty system in Scotland, and the following table shows that under the stimulus of the bounties the sea fisheries of Ireland made steady progress

In 1821 there were 36,159 fishermen and 7655 boats, in 1829 the numbers were 64,771 men and 13 119 boats A few years after the withdrawal of the bounty system (1836) the numbers were 54,119 men and 10,761 boats

THE BOUNTY SYSTEM IN IRELAND, 1819–29
(ANNUAL AVERAGES)

Years	Number of fishermen.	Barrels of herring (gutted with knives)	Total Bounty £s
1819–23	43 499	11,232	13 349
1824–29	59,308	25,136	16,103

[1] See A Review of the Domestic Fisheries of Great Britain and Ireland by R Fraser Edinburgh 1818

[2] Reference should be made to *Reports on the State of the British Herring Fisheries* 1798 p 264 under head *Report on the State of the Herring Fishery carried on from Ireland* and Appendix No 1 to the *First Report of the Commissioners of Inquiry into the State of the Irish Fisheries* Dublin 1836 p 1 entitled *Historical Sketch of the British and Irish Fisheries* by Sir T C Morgan

[3] See *First Report of the Commissioners of the Irish Fishery Inquiry* Dublin 1836 p 10

The reports of the Commissioners of the Irish Fisheries (1819–30) contain much interesting information as to the condition of the fisheries during the operation of the bounty system. In 1822 there was a famine in Ireland which reduced the people in the southern and western districts to a condition of unparalleled misery, relief being given by employing the people on fishery harbour construction. In 1823 the Commissioners reported " that were it not for the impulse given to a numerous and wretched coast population by the bounties granted by the present fishery enactments the value of the Irish fisheries might have yet remained in obscurity, and the energies of many thousands of the coast population of Ireland have still continued in the same state of inactivity in which the present enactments found them, and from which the bounty system has principally tended to rescue them." Before the bounty system had been in operation for five years it had excited a spirit of industry answering to every reasonable expectation, and orderly conduct was introduced where previously only lawless violence existed.

In 1824 the general condition of the labouring poor of Ireland was wretched in the extreme, as they were without any visible means of support, and the peace of the country was only maintained by an insurrection act and a large military force. On the other hand, the coast population were tranquil, and the fisheries afforded a source of employment, food and naval strength.[1]

In this year Parliament reduced the bounties considerably, in spite of the protests of the Commissioners, and in 1829 the bounties ceased. From 1809 to 1829 Scotland received in bounties for her fisheries £1,189,744, Ireland in the same period for the same purpose not more than £330,000.

In 1830 the Irish Fishery Department became nominally a branch of the Board of Inland Navigation, actually it was extinguished and nothing was done by the State to encourage the sea fisheries of Ireland until 1842, when the management was transferred to the Board of Works. Although the Board of Works only assisted the fisheries by means of grants for the construction of approved piers and harbours, by 1846 there was some recovery, and the fishermen and boats numbered 113,073 and 19,883 respectively. Then came the famine of 1847 and 1848, which the fishermen suffered to full extent. " So broken down by want were thousands of the fishermen that they were physically incapable of proceeding to sea." The number of men engaged in the coast fisheries declined rapidly, and in 1849 there were only 71,505 men and 18,100 boats. For the

[1] *Report of the Commisioners of the Irish Fisheries, Respecting the Discontinuance of Bounties.* Dublin, 6th March, 1824.

next twenty years there was a steady diminution, and in 1868 the fishermen numbered 39,339 and the boats 9184

The recent development of the Irish fisheries may be said to date from the passing of the Agriculture and Technical Instruction (Ireland) Act (62 and 63 Vict, c 50), and the various Acts constituting the Congested Districts Board for Ireland (54 and 55 Vict, c 48 to 9 Edw VII, c 42)

The authorities thus created may claim great credit for the resuscitation of the inshore fisheries of Ireland It would be impossible to give in detail an account of the extremely valuable work performed by these two organisations, but a short summary is indispensable Under Section 16 (d) of the Agriculture and Technical Instruction (Ireland) Act of 1899 a provision of £10,000 is to be made annually for the purpose of assisting the sea fisheries In addition there is a fund known as the "Sea and Coast Fisheries Fund," the history of which is interesting It is the residue of a sum collected in 1822 for the relief of distress in Ireland, and was raised by public subscription

This sum was vested in trustees known as the "Trustees to aid Sea and Coast Fisheries of Ireland," being afterwards transferred to the Commissioners of Public Works, who were authorised to make fishery loans therefrom, to such persons and upon such security as the Inspectors of Irish Fisheries should recommend In 1891 this was again transferred by the Purchase of Land (Ireland) Act to the Congested Districts Board, except £20,000, which was reserved for non-congested districts In 1899, by the Agriculture and Technical Instruction (Ireland) Act, this sum of £20,000—or what is was then represented by in cash, investments and outstanding loans—was placed at the disposal of the Department, and it is now partly used for the purpose of making loans to fishermen and partly for the furtherance of other objects in connection with the sea fisheries In the year ending 31st March, 1913, eighty three applications for loans were favourably considered by the Department, and a sum of £8,442 was granted for the purchase and repair of fishing boats and gear This expenditure, which is under Section 15 (c) of the Act, has been in the hands of the Department since the 1st April, 1900 The bad debts during this period of thirteen years amount to less than 1 per cent of the total advances Under Section 16 (g) of the same Act any surplus money may be applied by the Department for Agriculture, or rural industries, or sea fisheries, so that there are three separate sources from which funds are available for the improvement of the fisheries of Ireland

In congested districts the fishery administration is in the hands of the Congested Districts Board

The policy pursued by the Board is outlined in their annual reports. It is the west of Ireland fishermen with whom the Board is concerned. Their main object in promoting the development of the fisheries is not to turn farmers into fishermen, but to promote fishing of a kind that will enable the fisherman-farmer of the west coast to supplement his insufficient earnings from the land by receipts from sea fishing. The boats utilised for such purposes ought to be inexpensive and light. It would not pay to purchase a costly boat that might be used for only two or three months of the year; and it is important that a boat should not be so heavy as to cause difficulty in launching, or in moving it up the beach to a place of safety. Canvas curraghs or canoes, which are largely used along the coast of Connacht and in the counties Clare and Kerry, although such craft might provoke a smile from the skipper of a steam trawler, frequently bring their crews for the time engaged as much pay per man as if the canoe-men were paid "hands" in the employ of a limited liability company. The strongly built sailing boat of Connemara can also be used for net-fishing for herrings, while at other times of the year it is used for the carriage of turf for sale, of seaweed, and of general merchandise. The use of boats of the local type for such occasional fishing is often the wisest policy; they are sure to be cheap and safe, it is unwise to lead fishermen-farmers to incur heavy liabilities for boats and gear.

In the spring of 1901 the Congested Districts Board subsidised a few large herring boats from Scotland, the idea being to ascertain whether or not a profitable herring fishery could be established off the Donegal coast in spring and early summer; and as a result of this experiment herring fishing on a rather extensive scale was tried in May and June, 1902. The County Donegal herring fishery is now established on a commercial basis and requires little intervention on the part of the Board. The Board have also encouraged the mackerel fishing, organising a trade in Irish cured mackerel with the United States of America. They also experiment with steam drifters and motor boats. They have, however, found it difficult at most places on the coast to start or to revive long-line fishing by those fishermen who have been accustomed to use nets, and yet in average or good seasons there is no kind of fishing that would be so likely to ensure steady if comparatively small earnings to the fisherman-farmer.

Loans for boats and fishing gear are made widely along the coast. The Board also mount, bark and repair nets, and mount lines at their fishery station at Downings; at various other stations they store, bark and repair nets in use at each locality. Boat-building is carried on at Meevagh, Co. Donegal; the Board's cooperage at

Downings is most useful for training young men to become coopers, who, when their terms of apprenticeship are served, as a rule obtain positions as herring-coopers with commercial firms The Board's cooperage is by its sales self supporting Since 1892 the Board have spent a sum of £78 773 on marine works, including the construction of boat-slips, small piers, landing places and lights or beacons

In Scotland the condition of the inshore fisheries[1] has always been the concern of the authorities *The early attempts of the Scottish* Fishery Board to foster the inshore fisheries by means of a bounty system have already been touched upon Towards the end of the nineteenth century (1885 and 1895) the Fishery Board obtained powers to close large areas of inshore waters to trawling, as a measure of protection of the inshore fisherman The most recent Committee of Inquiry into the condition of the Scottish Sea Fisheries was that appointed in September, 1911, by the Secretary for Scotland It was required to inquire and report upon the character and national importance of the inshore and deep sea fisheries of Norway and other countries engaged in the North Sea fisheries, and the efforts made for the development of the fishing and fish-curing industry in all its branches, including (1) the system of fishery administration, including the constitution and function of the local committees formed for this purpose in Norway, and of any similar organisations in other countries (2) The facilities for research and for educating and training thoso engaged in these industries by the establishment of technical schools, museums, laboratories, classes or other special facilities (3) The nature of the various means of capture employed, and the methods (including any use of State credit) by which fishermen obtain the necessary capital to maintain the efficiency of their vessels and equipment, and to report in regard to each of the foregoing matters whether it would be advisable for similar action to be taken, with or without modification, in the case of the Scottish fishing industry, and if so what means should be adopted

This Committee visited every country in Europe interested in the North Sea fishing (with the exception of England) Before they reported, the President of the Board of Agriculture and Fisheries (in January, 1913) appointed a committee to inquire into the present condition of the inshore fisheries of England and Wales, and advise the Board as to the steps which could with advantage be taken for their preservation and development There is a

[1] Reference should be made to a paper by W Barclay on the "Fisheries on Banffshire" in the *Journal of the Banffshire Field Club* for 1917 for much curious and interesting information on the inshore fisheries of Scotland

marked contrast between the Scottish and English and Welsh Committees. The former consisted of five members, all closely in touch with the fishing industry, the latter consisted of thirteen members, none of whom, so far as could be ascertained, had any special aptitude for inquiring into the condition of the inshore fisheries, much less for reporting on steps to be taken for the improvement of an industry with whose operations they were quite unfamiliar. Consequently the reports published by these two committees are in striking contrast. That of the Scottish Fisheries Committee is a lucid statement of the present condition of the fisheries in the various countries visited.

The report, though one may disagree with certain of the recommendations, is an extremely valuable document, and one that merits careful and detailed study by anyone who wishes to become acquainted with sea fishery problems.

In so far as this report relates to the inshore fisheries, it may be considered here. There is some difficulty in defining or in framing a comprehensive definition of the "inshore fisheries." In any given case one could say whether one was dealing with inshore fisheries or inshore fishermen or not, but, nevertheless, the difficulty of framing a general definition remains. This difficulty was felt by the Inshore Fisheries Committee (England, 1913), and probably the best definition submitted was that by Mr. Fryer,[1] the Superintending Inspector of the Board of Agriculture and Fisheries, who stated "that inshore fisheries are fisheries carried on in waters frequented by fishermen working boats owned by themselves."

In Scotland, as the reports of the Fishery Board have indicated, and as the report of the Departmental Committee on North Sea fishing confirmed, there is, and has been for many years, a change taking place in the methods of sea fishing.

In particular, during the present century the extension of the steam drifter in the Scottish great herring fishery has greatly affected the distribution of the ownership of the means of production and the habits of the fishermen themselves. Up to towards the end of the nineteenth century the great herring fishery was carried on by sail boats owned by fishermen, working in concert with curers. The fishermen of a district looked more to the local fishing grounds for the bulk of their catch, and the case of a local group not visiting other grounds was not so exceptional as to-day.

The introduction of steam into herring fishing boats, meant a great increase in the area worked by any given vessel. In 1892 there were 44 steam fishing vessels other than trawlers in Scotland, in 1902 the number was 100, and in 1912 it was 824.

[1] Now Sir Charles Fryer.

The fishermen in some districts took the risk of using the new kind of vessel more readily than in others, and in particular the fishermen in the fishing villages on the south side of the Moray Firth took the lead in the innovation With the increase of the steam drifting fleet the sail boats began to diminish Crofter-fishermen tended more to give up their small boats and engage themselves as hired fishermen with East Coast boat-owners in greater numbers than before Some of the important districts, however, held to sail, notably Fraserburgh, which still has the largest fleet of sail boats on the east coast of Scotland (see Fig p 126) During recent years experiments have been made in the installation of internal combustion engines in the sailing drifters as an auxiliary means of propulsion So far as the districts taking part in the great herring fishery are concerned, Eyemouth is the one fishing village which has taken to motors on a relatively large scale

The number of sailing boats engaged in the great herring fishery has diminished from 2,228 to 1,486 between 1900 and 1912 This decrease in the number of boats has been accompanied by a diminution in the number of fishermen interested in fishery undertakings as owners of a share in the boats or gear The Fishery Board reports round about 1905 note as one of the reasons for the decline in the number of smaller boats that their owners were throwing them up and taking to service as hired fishermen on steam drifters The small fisherman is thus diminishing, and as the management of the steam drifters does not lend itself to divided ownership, it follows that the majority of the fishermen are becoming wage-earners

There is a growing feeling that the sail boat will not hold its own unless aided by some form of mechanical propulsion Boats depending on their sails alone go in smaller numbers to the late English fishery, as owing to the press of boats it is increasingly difficult to get in or out of Yarmouth Harbour without the use of mechanical power Apart from this, the sail boat is more restricted to the fishing in its own district In many cases the crew of a sailing boat are not under the same pressure as the crew of a steam drifter, the season's programme makes it easier for hired fishermen from crofting districts to take service in a sailing boat

Proposals were made to the Departmental Committee for State assistance to enable fishermen to provide themselves with modern fishing vessels These proposals were of three main types —

(1) Assistance to enable fishermen who have a share in a steam drifter to buy out the shore owners or lenders in cases where the terms imposed by the latter are irksome to them

(2) Assistance to enable fishermen who at present have no share in a boat to become part owners of a steam drifter

(3) Assistance to owners of sail boats to enable them to instal auxiliary internal-combustion engines in them.

The Committee decided in all cases against these proposals, and while we agree with their findings in the first two cases, we regret we cannot fully accept their reasons for rejecting the applications under the last heading. As a matter of fact, a Minority Report, signed by two of the members of the Committee, gives strong reasons for supporting the third application, and while we have the greatest respect for both Mr. Angus Sutherland, Chairman of the Scottish Fishery Board, and Dr. Wemyss Fulton, their Scientific Superintendent, neither of whom signed the Minority Report, we feel that there is sufficient force in the contentions put forth in this Minority Report to justify a recapitulation of a few of the main arguments.

The Minority Report states, " While we agree with our colleagues that no case has been established for State intervention in order to make it easier for fishermen to obtain an interest in a steam drifter . . . we do not think that . . . it is possible to overlook the case of the inshore fishermen using smaller first-class boats or second-class boats, either for the line fishing or, as is done on the West Coast, for the loch herring fishery."

As regards the large sail boat used in the great herring fishery, very few are now being built. The fish curer and merchant who helped the fishermen to get sail boats are no longer doing so. In districts such as Lewis and the Shetlands, where there is little outside help to be looked for, except from such directions, this is a serious matter, because in such centres there are few steam drifters.

If the process of decline goes on unchecked—as will likely be the case if it is nobody's business to take steps to hinder it—it will bring about a great change in the conditions under which the Scottish herring fishery is conducted. It is doubtful whether the country can afford to regard so great a change with equanimity. It means that the fishing community as a whole will be divided into " employers " and " employed." One result of this is a liability to trade disputes which tend to drive men out of the industry altogether. Fishing is an industry like agriculture which can be carried on—so far as the actual production is concerned—through a great number of relatively distinct undertakings on a small scale. Current opinion is undoubtedly in favour of keeping the population of the country, at least as well distributed as it is at present, and in conformity with this sentiment, harbour grants have been made to various localities to assist them in the struggle for existence. There are strong reasons for believing that the large sailing boat, equipped

with an auxiliary internal combustion engine, would hold its own in the great herring fishery

The Minority Report, after stating their reasons very fully, say, "It is because we think it of great importance to the well-being of the industry as a whole, that a type of boat intermediate between the bare sail boat and the steam drifter should be evolved to be used in the great herring fishery, that we recommend the provision of assistance from public funds for this proposal"

At present the Fishery Board for Scotland assists the inshore fishermen mainly in four ways —

1 By the dissemination of information as to market prices, etc

2 By loans

3 By grants in aid of harbour construction

4 By co-operation with the Congested Districts Board (Scotland) in developing the fisheries of the Minch and West Highland lochs

Under the first heading the Board furnish telegraphic information of the progress of the herring fishery Provision for granting loans to fishermen was made by the Crofters Holdings Act of 1886, the responsible authority to be the Fishery Board These loans were for the building of new boats, the purchase and repair of existing boats, the purchase of gear, and under the Public Works Loan Act of 1887 a grant of £30,000 was made to the Fishery Board for this purpose After 1891 no further loans were made on account of the great difficulties experienced in recovery, which were much enhanced by the inaccessibility of many of the fishing villages Accounts were finally closed in 1908, by which time 79 per cent of the total principal sum advanced was recovered

The assistance afforded by the Fishery Board for the preservation, maintenance and extension of the smaller fishery harbours, has been of vital importance to the inshore fishermen, and it is much to be regretted that nothing of the kind has previously been accomplished in England and Wales From 1st January, 1883, to 31st December, 1913, the Fishery Board for Scotland spent £111 555 on the erection and improvement of piers and harbours, in addition to this sum the localities concerned raised no less than £55 055 The Parliamentary grant for this purpose is made under 5 Geo IV, c 64

CHAPTER IX

PUBLIC FISHERIES FOR SHELLFISH

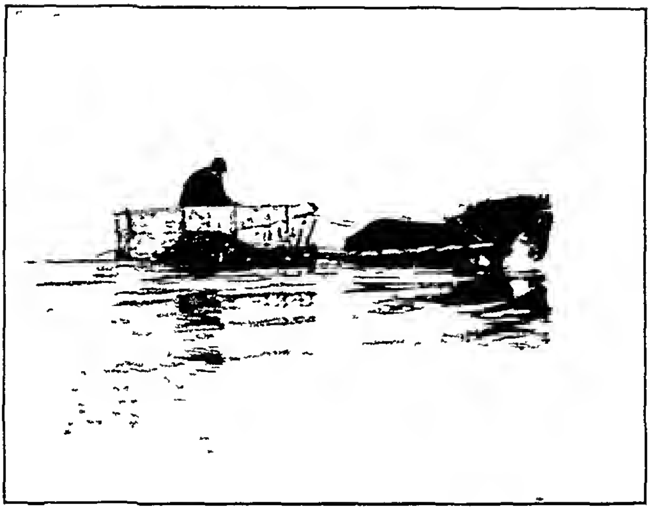
THE fisheries for shellfish fall into two main groups; those for crustacea, such as shrimps and lobsters; and those for mollusca, such as the cockle and mussel. As a general rule, the former fishery is carried on mainly or exclusively from boats of some description; whereas the latter is practically independent of either sailing or rowing boats, which even when used, are more for the purpose of locomotion and carriage, than for the actual operation of fishing. One feature is common to all the shellfish fisheries, and that is they are carried on exclusively within the territorial waters of these islands.

Of the inshore methods of fishing shrimping is one of the most important, as it gives employment to a large number of fishermen. The shrimp frequents sandy or muddy grounds in shallow water near the coast, it is fished for by boat fishermen, by fishermen-farmers, who fish from carts, and by longshoremen and boys who use push or stake nets (hose nets). The Lancashire coast is especially prolific of shrimps; its shrimping fleet includes some of the finest half-decked cutters to be met with anywhere. The men themselves are of a brave and sturdy type, whose precarious livelihood involves a constant struggle with the elements. Two men usually form the crew of one of these cutters, the net used is either the trawl or the "shank." The shank is in many respects similar to the trawl, but instead of a foot-rope it has a heavy wooden base. The shank exercises a ploughing action on the bottom, in a fair breeze is considered by many fishermen to be the more efficient instrument. The great objection to shrimping is that it takes place on the shallow sandy areas which are so much frequented by young fish that they have been termed nurseries. Since in order to capture so small a creature as the shrimp, the mesh of the net has to be extremely small, it follows that small fish are captured, occasionally in incredible numbers. The length of time the net is fishing is generally from an hour to an hour and a half. Only one trawl net is used at a time, but as many as four shank nets may be used simultaneously.

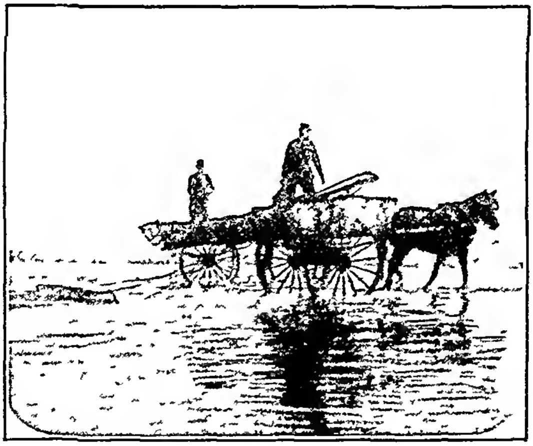
When the net is hauled on board the tail or "cod" end is opened and the catch shot out on deck Mingled with the shrimps are numbers of immature fish, including, as a rule, several kinds of flat-fish, such as dabs, plaice and soles, together with young whiting and codling All the round fish are dead or dying, but most of the flat-fish will survive if speedily thrown overboard

The debris in the net varies Crabs of bizarre appearance generally abound, near the Liverpool Bar coal is sufficiently plentiful to keep the stove on board going, and at the deposit buoy the miscellanea suggest the wreckage of a marine store While the second haul is in progress the crew are busy sorting the catch Usually a rough riddling process is first resorted to, and this results in the separation of the shrimps from the debris and small fish The separation is assisted by a rapid picking out of the larger shrimps remaining in the riddle Some caution has to be exercised in the handling of the catch owing to the presence of a number of "stingers," a small fish (*Trachinus vipera*) with poisonous spines in the dorsal fin The presence of these poisonous fishes, is one reason why shrimping is not carried on in the dark A second riddling over the side results in the smaller shrimps falling back to their watery home, the larger ones only being retained for the market The mesh of the riddle varies considerably, at Hoylake what is known as a threepence-halfpenny riddle is employed, i e one through the meshes of which three pennies and a halfpenny will just pass edgeways, at Liverpool a 'tuppence-halfpenny" or threepenny riddle, and at Southport a riddle resembling a sieve are used Immediately the shrimps are sorted out preparations are made for boiling them A bucket of sea water to which salt has been added is boiled over a dutch pot or stove on deck, the shrimps are poured into the boiling water and rapidly stirred for a few seconds and then spread out on the deck to cool Connoisseurs say that the quicker the boiling the better the resulting flavour The average number of hauls or drags per day is three or four, and from thirty to forty quarts of shrimps would be considered a good day's fishing

The measure of shrimps for trade purposes is a quart, and the price obtained by the fishermen fluctuates considerably, as a few days bad weather will put up the price over 100 per cent A fair average price for rough unpicked shrimps is fourpence per quart, although the price may be more than doubled in a few hours Owing to the various preservative methods now employed for picked shrimps (some of which are not free from the suspicion of excess of boracic acid) there is a tendency for the prices to remain steadier than was formerly the case In addition to the hundreds of fishermen who are more or less engaged in shrimping, the preparation of



SHRIMPING FROM A CART (SOUTHPORT). I.



SHRIMPING FROM A CART. II.

PUSH NETTING FOR SHRIMPS (BLACKPOOL)

STAKE NETS (HOSE NETS) SET FOR SHRIMPS (BLUNDELL SANDS)

the catch for the market is an important local industry on the Lancashire coast. There are about thirty shrimp-potters in Southport alone, and some firms deal with large quantities, utilising nearly all the shrimps caught on the coast, besides importing large quantities from the Continent. Hence the difference between " potted Southport shrimps " and " Southport potted shrimps."

Owing to the fact that shrimping is carried on to a large extent on the inshore " nurseries " for young edible fish, considerable attention has been devoted to the conditions under which this fishery is prosecuted,[1] and to the faunistic records of the grounds.[2] The observations of the Lancashire and Western Committee may be taken as a model of work of this kind. Mainly with the object of determining the destructiveness of shrimp-trawling to young fish a large number of statistical observations were made from a vessel *equipped in exactly the same manner* as *an ordinary shrimp trawler*. Hauls were made at regular intervals, and the results recorded. These records included the total number of edible fish caught, the number of quarts of shrimps taken, the number of each kind of edible fish with (originally) their average sizes. In the case of important fish, such as the plaice, later records include measures of the length of each individual fish captured. Physical observations, e.g. state of wind, weather, temperature of air and water, and salinity were also made.

A similar fishery to that for shrimps is carried on off the Lancashire coast for the so-called prawn (*Pandalus montagui*); a crustacean somewhat similar in appearance to the shrimp, and which must not be mistaken for the true prawn (*Leander serratus*). The " Fleetwood prawn " or shank or pink shrimp, as it is variously called, prefers a more stony or rocky substratum than the shrimp, and consequently where it is abundant undersized fish are not present in any quantity. The trawl used by the prawners is similar to that used by the shrimpers, except that the foot-rope is provided with small wooden rollers (" bobbins "), similar to those used by the steam trawlers. This device enables the prawners to drag their net on rough ground. The commoner fish taken in the

[1] As an example see, *Abhandlungen des deutschen Seefischerei-Vereins* (Berlin), Band V. (1) " Der Garneelenfang und die Garneelenfangapparate an der oldenburgischen, preussischen, und hollandischen Küste," von W. Decker; (2) " Den Garneelenfang und die Garneelenfanggeräte an der oldenburgischen, preussischen, und hollandischen Küste," von de Vries; (3) " Die Garneelenfischerei an der oldenburgischen und preussischen Küste bis zum Dollart," von Prof. Henking. Berlin, 1900.

[2] See *Annual Report Lancashire Sea Fisheries Laboratory* for 1900. Paper by J. Johnstone and J. T. Jenkins on " Statistics of the Mersey Shrimping Grounds," and *Annual Report Lancashire Sea Fisheries Laboratory* for 1907. Two papers by H. J. Buchanan-Wollaston on " Blackpool Closed Ground Trawling Statistics " and " Mersey Shrimp Trawling Statistics."

shrimp trawl are the plaice, sole, dab, haddock, whiting, cod and herring, to a less extent the lemon sole, brill and gurnard. Various inedible fish are also met with, the commoner being the solenette (frequently mistaken for the young sole), the stinger or weever, bull heads, sea-scorpions and sand-eels. Occasionally sprats are present in such abundance as to lead the fishermen to abandon shrimping or prawning temporarily for spratting. The same net is used, but the method of fishing is necessarily different.

The number of small fish taken is at times extremely high. On the 27th September, 1893, the Lancashire Fisheries cutter recorded the following haul when fishing near the Deposit Buoy in the Mersey Estuary. Depth of water, 5 fathoms. Bottom—sand. Length of drag, 2 miles, duration ninety minutes. Shrimp trawl of 21 ft. beam. Twenty other boats fishing in the immediate vicinity. Quarts of shrimps taken, 32. Number of fish: soles 12, average length 4½in.; plaice 10 407, average length 4½ in.; dabs 375, average length 4 in.; whiting 169, average 5 in.; codling 69, average 5 in. A few large fish are occasionally taken, and the local regulations permit the fishermen to retain these provided they are over 8 in. in length. All the small fish brought up in a shrimp trawl do not necessarily die. Flat-fish from 3 to 8 in. in length are not very hardy, but many are alive when the net is hauled aboard, and probably recover if put back into the sea immediately. Vitality experiments[1] have been made for various kinds of trawl nets, and these show that quite a large proportion of flat-fish recover when taken from the net and immediately placed in a tank containing running sea water. Flat-fish under 3 in. in length rarely survive, and the greater number of these are probably destroyed by shrimping. Small round fish, such as codling, whiting and haddock are invariably dead after being caught in the trawl. The mortality amongst fish caught in the shrimp trawl depends to a large extent on the rapidity and care with which the fisherman sorts his catch. This, apart from the personal factor, depends on a number of variable circumstances, such as the duration of the drag, the facility with which the net can be hauled, the temperature and other considerations.

It is to the interest of the fishermen to sort the catch quickly and get the shrimps boiled, and it may be taken for granted, since these men occasionally take to trawling for fish, that they are

[1] See Fulton, The Capture of Immature Fish, *8th Ann. Rept. Fish. Bd. Scotland*, 1890, Part III, pp. 183–187. Also Fulton, The Capture and Destruction of Immature Sea Fish, *9th Ann. Rept. Fish. Bd. Scotland*, 1891, p. 201. Herdman, *Report* Lancashire Sea Fisheries Laboratory, 1893, p. 23; 1894, p. 30. Borley, *Report on the Vitality of Trawl caught Plaice*. Marine Biological Assn. *of the United Kingdom* International Investigations, North Sea, Second Report, Southern Area, Cd. 4641, 1909, p. 1.

really anxious to preserve as many of these little ones as possible. As a rule the contents of the net are very rapidly sorted. But when the catch is large the process is more tedious, and as space in a shrimper is limited, part of the catch may be put into fish baskets unsorted while the remainder is being dealt with. Under such circumstances the young fish have practically no chance of surviving. With long hauls, large catches and in warm weather the mortality among the undersized fish is greatest. It is to be feared that a large proportion of the immature fish taken in the course of shrimp trawling is necessarily destroyed.

Wherever shrimping is carried on there are regulations which have for their object the minimising of this destruction.

In the first place a fishing ground may be closed entirely or during a part of the year to shrimping, as, for example, the fishing grounds off Blackpool. This method is quite effective, but if carried too far may result in the extinction of the shrimping community. Other regulations deal with the construction of the net. The beam must not exceed 14 (Port of Southampton) or 25 ft. (Lancashire and Western district). The shape of the net may be regulated. In the Lancashire and Western district it is not permissible to use a shrimp trawl if the length of the net measured from the centre of the beam to the tail end exceeds one and a half times the length of the beam. It is found that a greater length than this merely facilitates the capture of young fish and gives no increased yield of shrimps.

The size of the mesh is also regulated, for instance, in the Suffolk and Essex district, a shrimp net may not have more than sixteen meshes or thirty knots to the linear foot; in the neighbouring Kent and Essex district the regulation prescribes not more than 108 rows of knots to the linear yard. There does not seem much object in a regulation of this kind since the largest mesh which will capture a shrimp will also take a very small fish. Other regulations, e.g. the Eastern district, prescribe that the net must be raised and cleared not less than once in every half-hour, and the contents forthwith sorted and sifted in the sea at a place where the water is at the time not less than 6 in. in depth. This regulation is for fishing otherwise than from a boat. In some cases shrimpers fishing from a boat or cart must raise and clear the net once every hour. The objection to a by-law of this kind is that a constant supervision of every fisherman is necessary.

The female shrimp, like the crab and lobster, carries its eggs under the tail, but although the percentage of berried females to total females may be as high as 74·9 per cent in May on the Lancashire shrimping grounds, there seems no reason to anticipate a permanent

diminution in the supply of shrimps as a result of overfishing. Like other crustacea the shrimp undergoes a metamorphosis in development (see Fig. p. 198).

Fishing for crabs, lobsters and the true prawn (*Leander serratus*) is carried on by means of baited basket-like traps, known as "pots." The operations incidental to the fishing are carried out in open boats, e.g. the cobles of the Northumberland coast. This method of fishing is naturally to a large extent dependent on the weather, but the supply can to some extent be regulated, since both crabs and lobsters can be kept alive for lengthy periods, except in very warm weather, in store pots. The following table gives the statistics of the crab and lobster fisheries for 1913:—

	Lobsters.		Crabs.	
	Number.	Value £s.	Number.	Value £s.
England and Wales .	640,916	30,581	5,720,869	60,756
Scotland . . .	681,059	36,775	2,213,866	14,170
Ireland . . .	1,207,332	43,003	293,916	1,645
Total . .	2,529,307	110,359	8,228,651	76,571

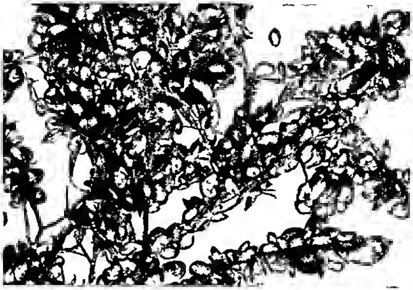
The lobster is a much more valuable species than the crab. In Scotland the extreme range of prices during the last ten years has been for lobsters from 95s. 1d. per hundred in 1909 to 108s. per hundred in 1913; for crabs from 11s. 9d. per hundred in 1905 to 12s. 10d. per hundred in 1912 and 1913. In Scotland the crab and lobster fisheries seem to be holding their own. In 1887 the number of lobsters landed was 681,100 and of crabs 2,215,700; and these numbers may be taken as a fair average year for Scotland. In England and Wales the statistical returns of this fishery are very inaccurate, but there is reason to think that the lobster fishing is falling off in some localities and holding its own or even increasing in others. It is difficult to make any general statement as to crabbing, but the fishery probably shares in the general decline of the English inshore fisheries.

In England and Wales both lobster and crab are protected by statute, and in certain localities by additional local by-laws.

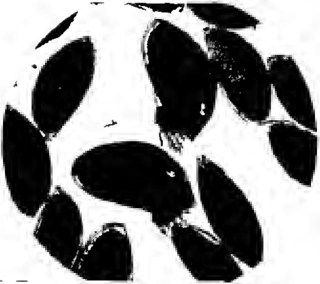
According to the Fisheries (Oysters, Crabs and Lobsters) Act of 1877 it is illegal to take, have in possession or sell any crab which measures less than 4 in. and a quarter across the broadest part of the back, or a lobster which measures less than 8 in. from the tip of the beak to the end of the tail when spread out flat. The same regulation applies to the "berried crab," but not to the "berried lobster." Certain of the local committees have extended the size limits for removal from a fishery to 4½ or 5 in. in the case of the crab,

EGGS AND YOUNG LARVÆ OF THE SHRIMP

NEWLY HATCHED LARVÆ OF THE SHRIMP.



MUSSEL FRY ATTACHED TO SEAWEED



SECOND LARVAL STAGE OF THE BARNACLE.
(Sometimes taken for Mussel Fry.)

and to 9 in. in the case of the lobster. In some localities the removal of the berried lobster is also prohibited. The extension of statutory protection to the berried lobster is a reform which is long overdue. In England and Wales the total quantity of lobsters landed showed a decline in the five-year period, 1905–09, as compared with 1900–04 of no less than 183,629 or 6·6 per cent. The detailed statistics for each of the fishery districts for this period are not available, but in the six districts in which the berried lobster is protected the total number of lobsters landed increased from 69,496 in 1907 to 102,865 in 1910.

This question of the protection of the berried lobster was first raised by the Northumberland Local Fisheries Committee at the first annual meeting of representatives of authorities under the Sea Fisheries Regulation Act of 1888 held at London in 1891. It has also been raised by one or other of the local committees at subsequent meetings in the Conferences from 1892 to 1898 inclusive. In 1905 the Northumberland Committee returned to the subject and at every Conference since (except in 1913) they have urged on the Central Department the necessity of providing further protection for the berried lobster. The same question will probably come up for consideration after the war. For years the Central Department refused to allow resolutions to be proposed at these Conferences, but the Marquess of Lincolnshire (then Lord Carrington, and President of the Board of Agriculture and Fisheries) permitted it in 1907. That year the Conference resolved unanimously that the berried lobster should be protected the whole year round. The next year it was proposed that " Legislation is necessary to make it a statutory offence to have in possession, to land, and sell the berried lobster during the whole year." The resolution was carried by thirty-five votes to four. At the same Conference the following resolution was carried unanimously, " That the taking, the sale and the possession of the berry of the lobster be illegal."

After twenty-three years' consideration the Central Department drafted a Lobster Bill. This measure provides for an increase of the minimum size for lobsters of half an inch. No provision is made for the protection of the berried lobster, but four other clauses deal with proposals for future legislation by Orders in Council and for a new standard of measurement of lobsters.

Apparently the Central Department object to the statutory protection of the berried lobster on the ground that " stripping," i.e. the artificial removal of the ova, would be practised by the fishermen on such a scale as to render the enactment of no effect, and in support of their attitude they produce evidence of this kind.[1]

[1] Board of Agriculture and Fisheries, *Annual Report of Proceedings under Acts relating to Sea Fisheries* for 1910, P. LXXVII. Addendum, " Memorandum on the Size, Sex and Condition of Lobsters."

"In the Lancashire and Western district the ratio of non-berried females to males points unmistakably to the widespread occurrence of "stripping," but as can easily be seen by a reference to the Central Department's own figures it points unmistakably to nothing of the sort The number of non-berried females and males in the Lancashire and Western district may be compared with those given for Cornwall

	Cornwall		Lancs and Western	
	Non berried females	Males.	Non berried females	Males
Under 9 in	986	815	11	0
" 10 "	1,061	831	1,643	1504
" 11 "	723	619	1,386	1337
" 12 "	598	442	1,102	1,028
Over 12 in	481	415	759	643

That is to say, the ratio of non berried females to males is in Cornwall 123 2 100 and in the Lancashire and Western district 108 6 100 So that if these figures prove that stripping is prevalent in the Lancashire and Western district, they also prove that it is still more prevalent in Cornwall, which is rather strange since there is no restriction in Cornwall on the landing of the berried lobster

The Board maintain that it would be more effective to increase the statutory minimum from 8 to 9 in, in support of their argument they adduce the following evidence —

Protective measure	Value sacrificed	Number protected	Ratio number to value
9 in limit	12 5 per cent	23 9 per cent	1 91
Protection of berried females	12 8 per cent	10 48 per cent	0 82

"From this table it would appear that the 9 in limit protects more than double the number of lobsters, with the same loss of value" The fallacy in this method of reasoning is ably pointed out by Meek,[1] who says, 'It will be noticed at once that the whole point and purpose of protecting the berried lobster has either been forgotten or ignored No one, to my knowledge, has ever proposed to protect the berried lobster as a lobster, the desire has been to protect her because of the crop of embryo lobsters which she is carrying If this essential point be taken into consideration, the number protected in relation to the value sacrificed assumes an altogether different aspect The number protected is the berried lobster and the number of the larvæ which will survive to maturity"

[1] Northumberland Sea Fisheries Committee Report by Professor Meek on the Memorandum issued by the Board of Agriculture and Fisheries on the Size Sex and Condition of Lobsters April 1912

There are now practically no public fisheries for oysters.[1] Oysters, whether native or imported from America, France, or Holland, are usually re-laid for fattening purposes in suitable creeks, and since the prosperity of the oyster-merchant's business depends on the purity of his wares it may be taken for granted that in the case of the great majority of oysters exposed for sale every effort has been made to secure their freedom from sewage contamination. The case of the other edible mollusca is entirely different. Cockles, mussels and periwinkles are gathered from their natural habitat and not from artificial layings in specially selected localities.

Cockles live in the sandy areas which are so frequently encountered on our coasts, and they are collected for sale as food for the public from Barra in the Outer Hebrides to the south coast of England, as well as in Ireland. The cockle usually lives embedded about half an inch below the surface, and on the whole it prefers a soft to a firm sand. It is capable of a limited amount of motion from place to place. Protruding above the surface of the sand, a keen observer may frequently see the siphons of the cockle, the tubes through which the respiratory and food-containing currents of water are in- and exhaled. The cocklers call these the " eyes " or " silver-eyes," but as a matter of fact the cockle has no visual organs. The position of the cockle may also be indicated by the " moss," a little algal tuft which is usually attached to the shell. Cockles are usually gathered by a hook, small rake or hoe. They are riddled, washed in sea water and packed in bags for the market.

The mussel differs considerably in its habits from the cockle. The former grows attached to a hard substratum, and it flourishes best in brackish water, in which there is usually an abundant supply of its food, mainly diatoms. Unlike the cockle it is sedentary, and is attached to the bottom by means of hyaline filaments—the " beard " or " weed " as the fisherman terms it. Mussels are gathered by hand, or where the beds are not exposed at low water, by means of long rakes. These long rakes are known in Lancashire as " craams." They are toothed rakes to the back of which a piece of netting is attached, the object being to prevent the mussels falling out when the rake is being drawn up. These " craams " are used from boats anchored in the estuaries, and they are attached to handles which are sometimes 50 ft. long. Their use requires considerable strength and skill. The rake is first thrown upstream against the current, and the head of the rake sinks to the bottom. The handle of the rake comes to rest on the right shoulder, and is worked so as to drag the teeth along the bottom on the mussel bed.

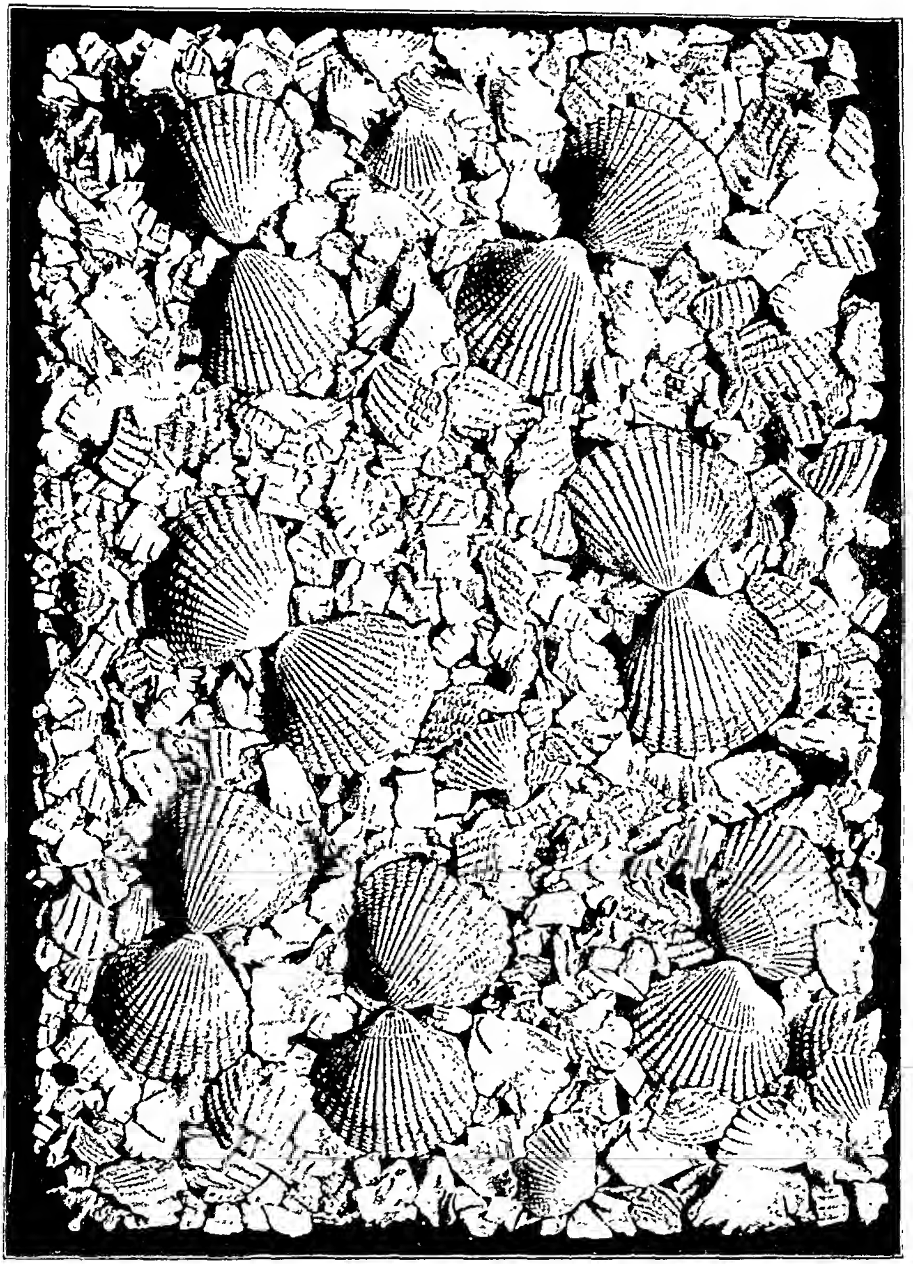
[1] For a description of a " private " fishery, see *The Oysters and Dredgers of Whitstable*, by A. O. Collard. London, Joseph Collard, 1902.

The mussels are hauled into the boat, where, after a sufficient number has accumulated, the small ones are riddled out, and returned to the beds The imposition of a size limit is necessary if the cockle and mussel beds are to be protected from the results of overfishing In the case of sedentary organisms like these it is possible completely to destroy a bed by unrestricted fishing, and there can be little doubt that the by-laws enforcing a size limit have been efficacious in preventing the wholesale extinction of public fisheries for shellfish Apart from man the chief enemy of the mussel is the starfish and certain species of flat-fish, particularly the plaice, dab and flounder The former pest attacks the mussel at any stage of its existence after it has settled down from its free swimming larval life, and the destruction caused in a comparatively short time by a horde of starfish must be seen to be realised The flat-fish only attack the mussel when immature and the shells are delicate

The chief enemy of the cockle is the " sea gull " Of the numerous species of bird which come under this designation the herring gull (*Larus argentatus*) and the lesser black-backed gull (*Larus fuscus*) are the chief offenders The use of the instrument known as the " Jumbo " involves the bringing to the surface of a number of small cockles, which, before they can sink again, are devoured by the gulls These gulls follow the cocklers at their work Three herring gulls shot on the Flookburgh sands (Lancashire) early in 1905, had respectively 13 13 and 24 whole cockles in their gullets, in addition to recognisable fragments of shells in the gizzard and intestine (see Fig p 202) Inquiries have been made from time to time as to the destruction to sea and shellfish caused by marine birds, but such investigations have hardly been sufficiently detailed and thorough to justify much reliance being placed on their conclusions [1]

Both cockles and mussels when gathered contain a certain amount of estuarine water, and if sewage be present in such water, the risk of consuming the shellfish must be very grave, more especially if the shellfish be consumed in an uncooked condition The authorities which regulate the gathering of shellfish from public fisheries are, in Scotland the Fishery Board, in Ireland the Inspectors of Irish Fisheries, and in England and Wales the Local Fisheries Committees The regulations are framed from a purely fishery standpoint, and deal principally with a close time and a size limit below which it is illegal to remove shellfish from the beds Although the Local Fisheries Committees have no power to specify a minimum size for the landing or sale of sea fish (*sensu stricto*)

[1] See Cumberland County Council *Report on the Food of the Black headed Gull (Larus ridibundus Linn)* by D L Thorpe and L E Hope Carlisle 1907 and Suffolk and Essex Fishery Board Report of Sub Committee appointed to make arrangements for and to investigate the feeding habits of gulls during the year 1913



COCKLES FROM CROP AND STOMACH OF A GULL.
(*Larus argentatus.*)

THE ARROW WORM
(*Sagitta*)

PERIDINIAN PLANKTON
(*Ceratium and Peridinium*)

they are empowered by the Sea Fisheries (Shellfish) Regulation Act of 1894 to fix the sizes and condition at which shellfish may not be removed from a fishery.

It is difficult to estimate accurately the quantity of cockles and mussels annually dispatched from the beds to the inland markets, since official statistics fail altogether in England and Wales, and are only partially available for Scotland and Ireland. In Scotland, 78,576 cwt. of mussels were gathered in 1913, but there is no separate return for cockles. In Ireland the statistics for 1913 are 1138 tons of mussels, value £2840, and 29,142 gallons of cockles, value £790. In the Lancashire and Western fisheries district, 74,996 cwt. of cockles and 96,277 cwt. of mussels were gathered from the beds in 1913.[1] While practically all the cockles are for human consumption, it must not be forgotten that some of the mussels are for bait for the long-line fishing. Cockles are usually cooked before consumption, the process of cooking tending to destroy any bacteria or other micro-organisms that may be present. Mussels are eaten either cooked or raw, in the latter case the consumer, as will be seen, takes on himself a serious risk of contracting enteric fever. Few people are aware of the enormous extent to which crude sewage is discharged into our estuaries and tidal waters. Most maritime municipalities discharge their sewage in an untreated condition into the sea, in some cases either in close proximity to, or actually on, beds from which mussels and cockles are gathered for human consumption. The Royal Commission on sewage disposal, first appointed in 1898, has *inter alia*, devoted its attention to the consideration of the pollution of estuaries and shellfish beds, and has published two voluminous reports on this subject.[2]

The third report of the Commission was published in 1903, and it advocated the setting up of a central authority for the settlement of differences between manufacturers and local authorities, the general protection of the sources of water supply, and the collection of facts and the scientific investigation of questions of general importance relating to the protection of water.

The fourth report (1904) deals more particularly with the pollution of tidal waters, with special reference to the contamination of shellfish, and it contains the following important recommendation: " After carefully considering the whole of the evidence, together

[1] Lancashire mussels have long been celebrated. See Pennant's *British Zoology*, Vol. IV, p. 3 (1777). " *Ne fraudentur gloria sua littora*. I must in justice to Lancashire add, that the finest mussels are those called Hambleton Hookers, from a village in that county. They are taken out of the sea, and placed in the River Wier within reach of the tide, where they grow very fat and delicious."

[2] Pollution of tidal waters, with especial reference to contamination of shellfish. Cd. 1883 and 1884. 1904. Pollution of estuaries and tidal waters. Cd. 4284. 1908.

with the results of our own investigations and local inquiries, we are strongly of opinion that the only way in which this evil can be effectively dealt with is by placing tidal waters under the jurisdiction of some competent authority, and conferring on that authority power to prevent the taking of shellfish for human consumption from any position in which they are liable to risk of dangerous contamination, and to enforce restrictions as regards waters, foreshores pits, ponds, beds and layings in which shellfish are fattened or stored as and when required' The fact that over fourteen years have elapsed since this report was published, and nothing has been done to carry out the recommendation justifies further consideration of the question

Bacteriological investigations which have been made from time to time, notably by Klein and Johnstone, have proved that contaminated shellfish when placed in clean sea water are able to clean themselves rapidly, and after a varying period, depending on the degree of infection, the mollusc is found to be almost free from bacteria Klein's[1] experiments were conducted with oysters more particularly, and these bivalves were infected both with the bacillus *coli communis* which is normally present in sewage, and the bacillus *typhosus* the specific organism of typhoid or enteric fever, in both cases the self cleansing was rapid and efficient From this it was concluded that the ordinary mollusca do not afford a nidus for the growth and propagation of bacteria As it seems well established that mollusca from reasonably clean, not absolutely sterile, sea water are quite innocuous, it is all the more remarkable that consignments from beds which are known to be polluted can be and are, placed on the markets with impunity

Johnstone[2] states that in the estuaries of the coasts of Wales and Lancashire contamination of the shellfish only occurs at or about low water At this period of the tide the channels are usually very narrow and shallow, and the extent to which the sewage is diluted with sea water is small, while the sewage may float on the surface and may flow over mussels which come dry at low water, direct contamination resulting The tidal currents are usually so strong that after a couple of hours' flood the sewage has become diluted to an enormous extent, and the water may be regarded as free from serious contamination

[1] Experiments and observations on the vitality of the bacillus of typhoid fever and of sewage microbes in oysters and other shellfish Investigations on behalf of the Worshipful Company of Fishmongers by E. Klein London 1905

[2] *28th Quarterly Report on the scientific work of the Lancashire and Western Sea Fisheries District* Liverpool C Tinling and Co 1914 See also The methods of cleansing living mussels from ingested sewage bacteria *Rept Lancs Sea Fish Lab* No 23 p 57 1915

If, therefore, polluted mussels are re-laid on the foreshore in such a situation that they will only become covered by the sea after the tide has been flowing for about three hours they will be bathed in clean sea water. When the tide has ebbed for a similar period the water again becomes seriously contaminated, since the depth and width of the channels diminish and the volume of inflowing sewage is proportionally large. But by this time the re-laid mussels are a-dry and are not exposed to pollution.

When clean, germ-free sea water flows over mussels they open their shells and a circulation is set up. Bacteria previously present in the alimentary canal and shell cavity of the mussels are washed out and the risk of re-infection is eliminated. The time required for the cleansing purpose varies. In tanks mussels cleanse themselves in pure sea water in twenty-four hours. A longer time is required when mussels are re-laid on the foreshore, since they are not continuously covered with sea water, but two days are usually sufficient. Re-laid mussels on the foreshore at Overton in the estuary of the Lune lost 90 per cent of the sewage bacteria present originally after two days. No reasonable objection could then be made to the use of these mussels as human food.[1]

It is no exaggeration to say that in a great number of reports of the medical officers of health for our larger boroughs and urban districts one constantly finds references to more or less isolated cases of enteric fever alleged to be due to the consumption of shellfish. In some instances the number of cases is so large as to justify the application of the term " epidemic " to the outbreak. It is unnecessary to specify the exact places where such outbreaks have occurred ; they are well known to students of public hygiene. The difficulties in dealing with shellfish are possibly greater than is the case with other articles of diet. The collection on the beds, the consignment by rail, the handling at the wholesale inland market, and the retail distribution by hawkers cannot be supervised by one and the same authority. But there is one obvious means which would naturally occur to anyone, to effectually prevent the sale of contaminated shellfish, and that is to stop the gathering from beds known to be polluted. Since the outbreaks of enteric at Southampton and Winchester[2] following the consumption of oysters

[1] One of the ablest summaries of the available information on this subject is that by Johnstone. See *23rd Quarterly Report* on the scientific work of the Lancashire and Western Sea Fisheries District. " Report on Mussel Beds in Lancashire and North Wales as Regards their Liability to Sewage Contamination." Liverpool, C. Tinling and Co., 1913.

[2] Report to the Local Government Board upon alleged Oyster-borne Enteric Fever, and other illness following the Mayoral Banquets at Winchester and Southampton, and upon enteric fever occurring simultaneously elsewhere, and also ascribed to Oysters, by H. T. Bulstrode. London, 1903.

much has been done both by the Fishmongers Company and the trade to rehabilitate the oyster in public confidence, and this mollusc, provided it be obtained from reliable sources, is now as safe as any other article of diet Unfortunately the mussel is still under suspicion, and it is not to the credit of the State that until quite recently it has made no efforts to protect those of its members who are the least able through ignorance and poverty to look after themselves

The administration and regulation of the shellfish beds are under the control of the local fisheries committees, and these bodies vary much in efficiency The late Dr Bulstrode, who had exceptional opportunity of estimating the value of their work in connection with the regulation of the public fisheries for shellfish, summarises in a report[1] to the Local Government Board the position of the local committees with regard to this matter This report raises the important question of the relative value to be attached, in judging the condition of shellfish, of topographical (including tidal), epidemiological and bacteriological evidence With regard to the local committees Dr Bulstrode says, " Each of these committees employs a clerk and one or more inspectors or fishery officers, but none of them possesses a medical officer of health or other officer with a public health certificate or diploma Several of the committees have at their disposal a steamer which enables their officers to move from one place to another with rapidity, such committees being the North-Eastern, the Eastern, the Lancashire and Western, and the Cumberland It is clear that from a purely inspectorial standpoint the services of these officers would be most valuable, and I feel sure from a fairly intimate knowledge of the character of their work that they would cordially co-operate with, and assist, whatever existing or newly created body upon which executive powers are conferred

Hitherto these committees with one notable exception have not concerned themselves with the public health aspect of the shellfish question Their duties have consisted solely in regulating the collection of shellfish in a manner calculated to yield the best commercial results to the fishermen, not only in the present, but in the future, and in carrying out their duties towards this end they have, in the earlier days of their history, encountered considerable opposition from the fishermen, who were slow to recognise that it was their interests alone which were being fostered But the officers of the Lancashire and Western Sea Fisheries Committee have made a detailed survey of the shellfish beds and areas

[1] Report on shellfish other than oysters in relation to disease by H T Bulstrode Cd 5313 Wyman and Sons London 1911

in their district, and of the sewers and drains which discharge in their vicinity. They have also from time to time made valuable bacteriological examinations of the waters and shellfish in different places, and have conducted experiments as regards the re-laying of shellfish, which are likely to prove of permanent value both to the shellfish industry itself and to the public health. Although, therefore, it might not be desirable, or, indeed, practicable, to place the administration of health measures in the hands of the Sea Fisheries Committees, the co-operation of these bodies is in every way desirable, and it might be the duty of their officers to draw attention to any unwholesome practices in connection with shellfish which they observed in the course of their routine inspectorial duties."

Not only has the Lancashire and Western Committee endeavoured to cope with the problem in the manner indicated by Dr. Bulstrode, but it has taken other steps with a view of eliminating this grave risk to public health. Before passing on to consider these steps, it is necessary briefly to review the manner in which shellfish are liable to contamination by sewage or deleterious organisms. Cockles and mussels are liable to contamination in one of four ways :—

1. On the beds where they are living and growing.

2. Whilst being prepared by the fishermen for the market through being washed in foul water.

3. During storage, either in tidal waters before being sent inland, or after arrival at the inland markets.

4. During preparation for sale.

Dr. Bulstrode gives a striking instance of an epidemic caused under the last section, where a large number of persons contracted enteric fever at Merthyr, owing to the consumption of cockles which had become contaminated through being prepared for sale by a person actually suffering from that disease.

Obviously all the above risks cannot be eliminated by the careful control of any one authority, the control must be shared by the medical and sanitary authorities of the inland boroughs on the one hand, and some body having authority over the beds or the foreshore on the other. As regards the pollution of shellfish on the beds, there are obviously two and only two remedies. Either :—

1. The gathering of the shellfish for direct sale as human food must be stopped, or

2. The discharge of the sewage must be prevented.

To consider the latter alternative first, one soon finds that, speaking generally, it is impossible to prevent the discharge of sewage or other deleterious matter in close proximity to public shellfish beds. According to the Public Health Act of 1875 sewage or filthy

water must be freed from all excrementitious or other foul or noxious matter before it is conveyed into any natural stream or watercourse, or into any canal, pond or lake

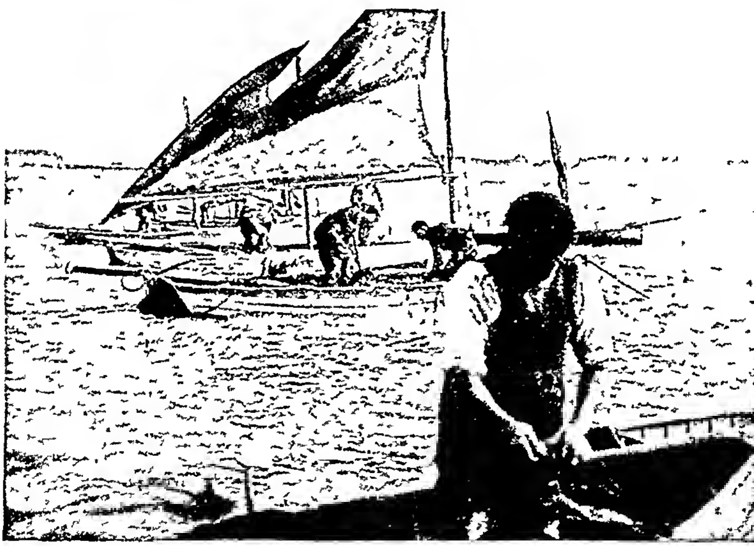
But the section has not been interpreted as applying to tidal waters The Rivers Pollution (Prevention) Act of 1876 does not apply to tidal waters The Statute law, therefore, does not prohibit the discharge of polluting liquids into tidal waters Some of the local fisheries committees have a by law prohibiting the deposit or discharge of any solid or liquid substance detrimental to sea fish or sea fishing, but as there is a proviso that this prohibition is subject to any powers conferred on any sanitary or other authority, it can easily be seen that as a means of preventing contamination of shell-fish beds the by laws are farcical The carrying out of sewage schemes by various sanitary authorities generally involves a preliminary Local Government Board inquiry

There appears to be no uniformity in the methods adopted for the purification of sewage by the various sanitary authorities which discharge their sewage into tidal waters, so one finds in close proximity one authority with modern methods of sewage treatment prior to discharge, whilst another authority discharges absolutely crude sewage It is objected by Dr Bulstrode (and others) to modern treatment that " there is at present no known method of sewage purification which will effectually remove the organisms from such sewage " Granted, but, at any rate, as far as sea fish are concerned, a great improvement would be effected if all sanitary authorities discharging sewage into tidal waters were compelled to remove solid matters prior to discharge The removal of solid matters is a comparatively easy matter, and has two advantages, it prevents de-aeration of the water and the consequent suffocation of the fish, it also prevents the formation of foul sludge banks, which are often clothed with certain green seaweeds,[1] whose decay forms an extensive nuisance

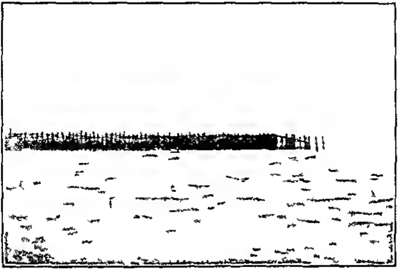
The procedure in the case of inquiries relating to the discharge of sewage in tidal waters, or on the foreshore, was formerly open to serious criticism, but an improvement was effected in 1910 Previously it was not always possible for the local fisheries committee to be represented at such inquiries, as they were not in receipt of information of the place and date of inquiry In 1910 the local committees were notified officially by the Board of Agriculture and Fisheries —

" It has been thought desirable to modify the procedure hitherto adopted when consulting local fishery authorities with regard to sewage schemes It has been arranged that, in future in all cases of

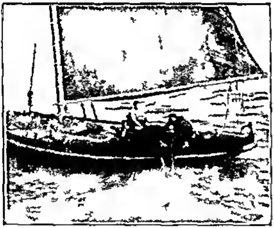
[1] *Ulva latissima* (Sea lettuce)



MUSSELING AT MORECAMBE



A STAKE NET



A FLEETWOOD PRAWNER

applications to the Local Government Board for sanction to loans for outfall sewerage works below high-water mark, that Board will forward to the Board of Agriculture and Fisheries, for communication to the local fishery authority concerned, a statement giving particulars of the scheme supplied by the promoters; and will notify the fishery authority of the date and place of the local inquiry into the application. It will then rest with that body to make at the inquiry any representations, in the interest of the fisheries, which may be thought desirable. The local fishery authority will thus be enabled, in those cases to which the arrangement applies, to bring their views directly before the Department concerned with questions of public health, and it is hoped that, as a general rule, the arrangement will result in their having earlier notice of schemes than has hitherto been possible."

It will be seen, therefore, that the local fisheries committees have no power (beyond an occasional protest against new undesirable sewage schemes) to prevent the pollution of the mussels while they are on the beds.

The other alternative is the prohibition of the gathering of shellfish from beds known to be seriously polluted. This alternative was tried by the Lancashire and Western Committee as long ago as 1904, when they drafted a by-law for the closing of a polluted mussel bed for an indefinite period. This particular bed was subject to contamination of the grossest possible kind; several cases of enteric fever were proved conclusively to have resulted from the consumption of mussels removed from it. These facts were not in dispute. In drafting the proposed by-law the Committee relied on their powers under the Acts of 1888 and 1891 and 1894. According to the Act of 1891 (54 and 55 Vict., c. 37), " The powers of a local fisheries committee shall extend to making by-laws to be observed in their district . . . prohibiting . . . entirely the fishing for or taking of . . . any specified kinds of sea fish . . . during any period." The Act of 1888 states that the expression " sea fish " shall include . . . mussels, cockles and other kinds of crustaceans and shellfish.

The Act of 1894 (57 and 58 Vict., c. 26) states, " The powers of a local fisheries committee shall extend to . . . the fixing of the . . . condition at which shellfish may not be removed from a fishery." One would have thought that these two clauses taken together would have proved sufficient to render possible the prevention of the removal of mussels known to be grossly contaminated with deleterious bacteria, and, as the " condition " of each individual mussel could not be the subject of an independent bacteriological examination before it was put in the musseler's bag, the only alter-

native was to close the bed altogether The Central Authority, in this case the Board of Agriculture and Fisheries, thought otherwise, and in its efforts to assuage the crudities of local administration, replied in the following terms to the Committee —

" The Board are advised that the powers of a local fisheries committee under the Sea Fisheries Regulation Acts do not extend to the making of by-laws for the closure of a mussel bed or other fishery for shellfish for the purpose of protection of public health The Board, therefore, regret that they are unable to confirm the by law submitted "

It should be noted that no other authority had the power to close a polluted shellfish bed

Undeterred by this sapient reply to their efforts, the Lancashire and Western Committee has, at the annual statutory meeting of Sea Fisheries Authorities, on no fewer than eight occasions drawn the attention of the Central Authority to this evil To detail the arguments set forth at these Conferences would be wearisome, it must suffice to draw attention to the transactions at two recent meetings In 1910 the following resolution was proposed and seconded by Lancashire representatives, and carried unanimously

" That this Conference urges the Board of Agriculture and Fisheries to make strong representations to the Local Government Board to promote legislation with a view to giving the local fisheries committees of England and Wales, or some other authority having jurisdiction over an extensive area of sea coast, power to close shellfish beds that are proved to be contaminated with sewage to such an extent as to be likely to cause the illness or death of the person or persons consuming them "

In 1911 the Conference was informed by the Marquis of Lincolnshire (then Lord Carrington and President of the Board), that " the attention of the Local Government Board was called in due course to the discussion on the subject of the pollution of shellfish beds (at the Conference of 1910), and on 6th June last (i e 1911) the President of the Local Government Board intimated in the House of Commons that his department is almost in a position to draft legislation on the subject Meanwhile the seriousness of the question cannot be disguised or diminished To give an example, the Lancashire and Western Committee knew that if mussels were gathered from a certain bed in their district for use as food an outbreak of fever was inevitable The mussels were gathered (there being no authority to prevent it), and the epidemic of typhoid followed

In February, 1915, the Local Government Board, acting in the provisions of the Public Health (Regulations as to Food) Act, 1907, drafted regulations prohibiting the sale of shellfish likely to cause

danger to public health. In an explanatory letter accompanying the regulations the Board say that no opportunity has yet arisen for altering the law affecting the sale of shellfish for human consumption in the way recommended by the Royal Commission on Sewage Disposal, so the present Order had been made with a view to the provision of an alternative procedure under powers which the Board already possess.

Briefly expressed, these regulations empower a local authority (e.g. the Town Councils of Manchester or Birmingham), on receiving a report from their medical officer of health that persons residing in their district are suffering, or have recently suffered, from infectious or other disease attributable to shellfish, to require any fishmonger supplying shellfish in the district to furnish within a reasonable time a list of all the layings from which his supply is derived or has been derived within the last six weeks.

If the suspected shellfish be traced (e.g. to Morecambe or Conway), the local authority in which the disease has broken out, or in which the shellfish are suspected, shall make a representation to the local authority from whose area the suspected shellfish are obtained. The latter authority, in the purely hypothetical case under consideration, the Town Council of Morecambe or Conway, must then give notice in the case of public fisheries, to all persons interested to appear before them, within a period of not less than twenty-one days, to show cause why an Order should not be made prohibiting the distribution for sale for human consumption of shellfish brought from the suspected layings, unless such shellfish have been re-laid in pure water for such period as the local authority may direct. If the fishermen cannot prove their shellfish to be above suspicion then the local authority (the Town Council of Morecambe) shall forthwith make an Order. If the local authority in whose area the shellfish beds are situate fail to carry out the regulations, then the complaining local authority (Town Council of Manchester) may appeal to the Local Government Board, and the Board, if satisfied after enquiry that an Order should be made, may require the recalcitrant local authority in whose area the beds are situate to make such Order as the Board may direct. The regulations provide for the right of appeal to the Local Government Board against an Order by any person interested. When the Order has been made by the local authority under the regulations, any person who for human consumption sells, exposes, distributes, or offers for sale, or has in his possession for the purpose of sale contrary to the Order, shellfish brought from the beds, is liable to a penalty not exceeding £100, and in the case of a continuing offence to a further penalty not exceeding £50 for every day during which the offence continues.

The first regulating Order made under these regulations was by the Cowes Port Sanitary Authority for shellfish in the River Medina (12th August, 1915), prescribing a period of three months during which shellfish from that river must be re-laid prior to sale for human consumption There are, however, no important shellfish beds in that river

The second and third inquiries under the Local Government Board Statutory Rules and Orders, No 125 were held at Lancaster on the 25th January, 1916 for mussels in the estuary of the Lune and at Preston on the 2nd February, 1916, for the mussels in the Ribble In both these estuaries there are not inconsiderable public fisheries for shellfish, mainly mussels In each case the Town Council, or rather a Committee of the Town Council, acting as the Port Sanitary Authority, called on the fishermen " to show cause why an Order should not be made prohibiting as the circumstances may require, the distribution for sale for human consumption of shellfish brought from the layings " in the Lune and Ribble respectively, " unless such shellfish have been re laid in pure water for such period as the local authority, on the advice of their medical officer of health may direct '

It soon became evident that there is considerable difficulty in putting into force the regulations, when any opposition is offered, and in each case the inquiry was adjourned *sine die* A second inquiry was held at Lancaster in February, 1918, with like result Nothing was done at either place to improve the ' purity ' of the local mussels, until in December, 1918, the Local Government Board issued an Order preventing the sale of Lune mussels for human consumption until such mussels had been suitably cleansed The effect of this Order was to close the mussel beds entirely

An alternative mode of procedure which appears to offer better results is to obtain a special Act of Parliament for the regulation of mussel fisheries in certain defined areas This has been done by the Corporation of Conway for that estuary, and by the Lancashire and Western Committee for Cardigan Bay Under these Acts the authorities obtain powers to compel the local fishermen to subject their mussels to a process of cleansing before they are sent to the inland markets The details of these powers are set forth in the Acts [1] At Conway the Corporation has been assisted by the Board of Agriculture and Fisheries Tanks have been constructed and mussels from the less polluted parts of the estuary are subjected to a treatment in chemically sterilised sea water It is claimed that practically all the bacteria of the *B coli* and allied types are

[1] Sea Fisheries Conway Provisional Order Confirmation Act 1912 (2 and 3 Geo 5)
Sea Fisheries Cardigan Bay Provisional Order Confirmation Act 1915 (5 and 6 Geo 5)

removed from the mussels by this treatment; so far no details of this method have been made public. Incidentally the process is somewhat expensive, and could only be carried out where there is a fairly important mussel fishery.

In Cardigan Bay the Lancashire and Western Committee have proceeded on slightly different lines. Mussels are accepted from any part of the estuaries of the Dovey and Mawddach and placed in special tanks for forty-eight hours, where they live in ordinary sea water which only enters the tank near the top of the tide, and on Johnstone's theory should be free from serious contamination. It is claimed that this treatment results in the elimination of all serious risk of the mussels becoming carriers of infection. Towards the end of 1918 the Board definitely condemned this system as unsatisfactory, and in a phrase reminiscent of the first commandment they say that no practicable process of cleansing can be regarded as satisfactory which does not follow in general the lines of the system initiated by them at Conway.

The by-law compelling the local fishermen to place their mussels in the tanks for cleansing purposes for not less than forty-eight hours cannot be enforced unless approved by the Board of Agriculture and Fisheries. Since the Board have definitely refused their consent the tanks are worked on a voluntary arrangement, so far loyally acquiesced in by the fishermen, subject to a proviso that mussels within a certain specified distance of the sewer outfall may not be gathered at all.

Matters are thus at a deadlock so far as these Cardigan Bay mussels are concerned. Indeed, the only logical outcome of the Board's attitude is to prevent the sale of all mussels gathered for human consumption everywhere in England and Wales, until such mussels "have been treated under strict supervision in water which has been previously sterilised, and are subjected to other precautionary measures designed to secure their immunity from subsequent contamination."

It remains to be seen whether the Board has the courage of its convictions.

CHAPTER X

THE EDUCATION OF FISHERMEN

THE education of the fishing community may be considered from two standpoints There is firstly the education of adults, who may be considered for this purpose to be all persons over sixteen years of age, and secondly the education of boys and apprentices *The former group is* sharply distinguished from the latter, since its requirements are altogether different The provision of educational facilities for fishermen who have passed the apprentice stage is by no means a simple matter Persons who are engaged in work on land can almost invariably, provided they possess the necessary zeal, profit by attendance at technical classes with little or no disturbance to their employment The fisherman, however, stands in an entirely different position The nature of his calling necessitates his absence from home for more or less irregular and lengthy intervals, and absence from home in his case naturally means the cutting off of any educational facilities provided at his home port Trawlers, as a rule, work regularly throughout the year In the case of a deep-sea smack the average fishing voyage will last for from four to seven days, but the steam trawlers may be absent from port for ten days to three weeks on a single voyage, and voyages of over a month's duration are occasionally made The steam trawler usually makes a particular port his headquarters, e g Fleetwood, but the smacks usually make the nearest port to the fishing grounds their temporary headquarters Thus a Brixham trawler may land his fish at one time at Milford and at another time at Fleetwood, a Hoylake smack whose crew will be entirely Cheshire men will have temporary headquarters for months at a time, at either Liverpool, Douglas or Bangor (North Wales) In the latter case it would be almost impossible for the Cheshire County Council to arrange for the technical education of these men The case of the drifter is somewhat different Here we have a seasonal fishing followed by an interval of rest, the vessels being laid up entirely for a certain period, often of several months' duration It is, therefore, easier for these men to make themselves more efficient navigators by attending some course of technical

instruction. For a great portion of the year the fisherman is isolated, and this reacts on him in several ways. To a greater extent than in the case of other working men, he is confined both when at his work and in his leisure hours to association with men of his own class; and as the older fishermen are even at the present day to some extent illiterate it is not surprising to find that they are as a class extremely conservative. Quite a number of the older fishermen have accumulated property which is beyond the reach of men of the artisan class ashore, and since these men have proved successful from a worldly standpoint in spite of their obvious lack of education, it is not surprising that many of the younger men—who, it must be noted, are under the commands of the older men at sea—are apt to depreciate the advantages of study, and avoid or shirk the unfamiliar labour associated with the commencement of work at school or class. A fisherman of studious disposition or inquiring turn of mind labours under serious disadvantages which are not present in the case of shore artisans. During the time he is at sea his work is practically continuous except for intervals for meals and sleep. In addition to the regular watches which must be kept on all sea-going craft, the fishing operations frequently mean the employment of all hands whether it be their watch below or not. Competition in the fishing trade is now extremely keen, consequently the intervals between successive voyages tend to get smaller and smaller, so that it is only the exceptional man who, during the two or three tides his vessel is in port, can spare time from his social and family claims for attendance at the fisherman's school. The education of the older fishermen should, we think, be confined strictly to those subjects an accurate knowledge of which will tend to make him a more efficient workman. Much of this knowledge he accumulates from day to day at sea, the only place where most of it can be learnt; instruction on shore should be devoted to the co-ordination of this experience, and the elimination of erroneous deductions based on imperfect observation; an endeavour should also be made to convey to the fisherman a true appreciation of his relationship to his environment. The only subject which appeals to the adult fisherman at present is "Navigation and Seamanship," and this, not because he really believes he can learn anything of this or any other subject at school, but because the vagaries of a Government Department require him to pass an examination in this subject in addition to a little reading, writing and arithmetic of a simple character. As a result of success at the examination, the Board of Trade bestows certificates of three grades, "second hand," "skipper" and "extra skipper."

In accordance with the regulations of the Merchant Shipping

Acts (1894 and 1906), a fishing boat being a trawler of 25 tons tonnage or upwards shall not go to sea from any port of the United Kingdom unless provided with a duly certificated skipper and a duly certificated second hand This requirement was extended to all liners and drifters of 50 tons gross tonnage and upwards, propelled by steam or other mechanical power, by an Order of the Board of Trade, dated 20th December, 1909, such Order to come into force on 1st July, 1910 Service certificates were granted, as in the case of trawlers, to men acting as skippers or second hands who complied with certain conditions when the regulation came into operation The official regulations issued by the Board of Trade contain full information of the requirements at each examination Apart from these examinations in Navigation and Seamanship there is no test required from fishermen, unless ability to read, write and cipher be considered one The question of instruction in other subjects, such as first aid or ambulance work, net-making and net-mending, the use of internal-combustion engines in fishing craft, to adult fishermen can hardly be considered in detail here On the whole, and subject to certain reservations, the available evidence is against the instruction of adult fishermen in these subjects The tendency of recent years is to raise the standard of attainment necessary for success at the Board of Trade examinations, but it seems absurd that the same class of certificate should be granted to the skipper of a smack which rarely exceeds a distance of 50 miles from his home port and to the man who takes a large steam trawler to the White Sea in the depth of winter Registration of the vessel in the Isle of Man affords one way of escape from the rigours of the Board of Trade examination, another method is to endeavour, in the case of a sailing trawler, to get the vessel registered as a fraction of a ton under 25

In Germany[1] there are three different professional tests laid down by the State for fishermen The German fisheries are for this purpose divided into (1) Coastal, (2) Lesser deep-sea (to 61 N latitude and in the English Channel), (3) Middle deep sea (to 61 N latitude 30 W and 50 E longitude from Greenwich), (4) Greater deep-sea (anywhere not included in the above, e g Morocco and the Spanish coasts) The skipper of a coastal fishing boat is not required to pass an examination The skippers of vessels belonging to classes 2 to 4 inclusive must pass examinations of varying degrees of difficulty

As an increasing number of fishing vessels of all kinds are now propelled by steam some notice of the education of engineers for

[1] See *Deutscher Seefischerei Almanach* for 1905 Hahn sche Buchhandlung Hanover und Leipzig

fishing boats is necessary. In the first place there is no special examination by the Board of Trade for engineers of fishing vessels, as the horse-power of the engines on these vessels does not usually exceed the Board of Trade limit of 99 nominal horse-power, above which it is necessary to have a certificated man in charge. At present this limit applies only to foreign-going steamers.

To sit for a second-class certificate (engineers) of the Board of Trade, a man must have served an apprenticeship, and subsequently serve at sea for not less than twelve months in a foreign-going steamer, or eighteen months in the home trade. To become a first-class engineer the sea service is the same, but six months in a foreign-going steamer is essential. Time served by engineers on board fishing vessels is only accepted by the Board of Trade on the following conditions. Two months' service in a fishing boat to be equivalent to one month's qualifying service. Candidates for second-class certificates may perform all their sea service in sea-going trawlers, but they must have been on regular watch on the main engines or boilers, and the vessels must not be less than 66 nominal horse-power. Candidates for first-class certificates must have served in vessels of at least 99 nominal horse-power, and have been in charge of a watch on the main engines or boilers. They must, in addition, have served in a qualifying capacity for at least six months in a foreign-going cargo or passenger steamship, or nine months in a home-trade cargo or passenger steamship. These regulations exclude all steam trawler engineers from first-class certificates, and all but a few from the second class. In order to enable them to qualify with the Board of Trade requirements a reduction of the nominal horse-power to 35 is necessary. Probably as a result of these requirements and the absence of a special examination there is no provision in England and Wales for the education of these men, with the doubtful exception of Grimsby. The need of some test for fishing vessel engineers has long been felt by the owners of these vessels, who have consequently instituted examinations and grant their own certificates of competency. For instance, the Aberdeen Amalgamated Engineers Examination Board, affiliated with the United Kingdom Steam Tug and Trawlers Insurance Association, and the Aberdeen Mutual and General Marine Insurance Company have granted such certificates since the commencement of 1910. While this examination is primarily intended for engineers on steam trawlers, some of the owners of steam drifters look for men who possess this Aberdeen certificate to take the position of drivers on steam drifters. In 1909–10 the Fleetwood Fishing Vessel Owners Association instituted an examination for engineers, and in the first year 59 certificates were granted

to chief engineers, 33 to seconds, while 62 certificates issued by other examining bodies were endorsed Similar examining bodies are now in existence at most of the leading steam trawler ports

The education of juveniles, including apprentices, may properly be considered apart from that of the older fishermen In the first place it must be made clear that in England and Wales no boy under thirteen years shall enter into any apprenticeship, and a boy under sixteen years shall not be taken to sea in a fishing boat of 25 tons and upwards to serve in any capacity unless bound by an indenture of apprenticeship Apprenticeship is now almost extinct[1] in the fishing trade, with the exception of the Ramsgate smacks; on board of which there were from forty to fifty apprentices engaged early in 1914, not a large number for the 159 first-class fishing smacks registered at Ramsgate

Consequently in almost all English and Welsh fishing ports no boy goes to sea in a fishing boat of over 25 tons tonnage until he is sixteen years of age The consequence is that between the ages at which the fishing boys leave the elementary day school (13 or 14) and the time when they go to sea (16) they are engaged in casual employment ashore, and no systematic effort appears to be made by the local education authorities to provide suitable instruction which would make these boys more efficient seamen and fishermen when the time comes for them to go to sea [2]

It is a matter for regret that in both large and small fishing ports in England and Wales there is a large number of lads and boys whose energies are running to waste Employed during the day as errand boys or in odd jobs about the docks, in the smaller fishing villages as golf caddies, in hotel service their leisure hours are often spent in undesirable surroundings The Education Act of 1918 when it comes into operation will presumably alter all this

In Belgium[3] the education of young lads who wish to become fishermen is specially provided for, and deserves more than a passing reference There are three types of schools available for these boys —

(1) Professional Fishery Schools, subsidised by the State These schools are aided by the State to the extent of about three fifths of their expenditure, the other two fifths being borne by the com-

[1] Before the passing of the Merchant Shipping (Fishing Boats) Act of 1883 (since repealed by and incorporated in the Merchant Shipping Act of 1894) there were in the marine service and on fishing vessels 15 704 sea apprentices in 1903 there were only 1073 such apprentices of whom about 539 were apprenticed to the sea fishing service

[2] See Report of Committee appointed to consider the present conditions of the Apprenticeship System in the Grimsby Fishing Trade and in what way these can be improved June 1903

[3] Obviously what follows relates to pre war conditions

munities. In addition, there is the famous École libre de Pêche at Ostend, directed by M. l'Abbé Pype, who himself does much of the practical teaching.

(2) The École des Mousses de l'État, a Government school where all boys are admitted whose fathers are, or have been, employed in the Government service, i.e. on the mail steamers, or in the pilot, customs or fishery services.

(3) The École Ibis (l'École des pupilles de la pêche). This institution, the most complete of all the fishery schools in the country, was originally a charitable institution founded in 1906 by the then Crown Prince for the purpose of educating the orphans of fishermen.

The Belgian Government encourages the apprenticeship of fishermen by the payment of premiums to skippers for enrolment of boys in the crews of fishing boats.

The general aim of the fishery schools is to give the young fisherman or intending fisherman a thorough insight into all matters concerning fishing and navigation. He is taught the use of the chart, the log, the lead, the sextant; the construction and manipulation of the steam capstan; the different kinds of fish, and where and how to get them; the making and mending of nets and sails; the laws and regulations to be observed by fishermen, elementary hygiene and first aid and other matters. A short description of M. l'Abbé Pype's school at Ostend is given, as it is decidedly worthy of emulation. The premises are spacious and consist of two blocks of buildings separated by a courtyard. In the smaller block the lower part is the common instruction room, where the boys are taught net-making and mending, sail-making, knots, splices, hitches, bends, the rule of the road and ambulance work. The room is completely fitted up with apparatus necessary for making and mending nets and sails; there is also a large collection of charts and instruments, such as sextants and logs, models to illustrate the rule of the road and other apparatus. The upper room is mainly a museum of fishery and maritime objects, but it also has apparatus for class-instruction in navigation, and a large model showing the nature of the sea bottom. In the courtyard there is a model of a boat which serves for various exercises in rigging up tackles and managing sails. The larger block of buildings serves for specialised instruction and investigations, it contains also the administrative offices. Here the boys are taught to tan and bark nets, and to extract oil by boiling from fish and fish refuse. In a machinery room are fitted up a donkey engine and a petrol motor. A donkey engine, it may be explained, is a subsidiary engine used on board ship for auxiliary purposes (such as pumping or hoisting in freight),

unconnected with the task of the main engines, i e the propulsion of the ship In sailing trawlers the donkey engine will be the only one on board, and will be used for hauling the net No special engineer is carried, the engine being looked after by the fishermen

Another room is equipped to show the various processes of smoking and preserving fish There are smoking frames and chambers with steam boilers for cooking by steam Attached to the school, but independent, except that it is under the same direction, is a department for carrying out investigations relating to the economic and commercial aspects of the fishing industry This includes not only well-equipped laboratories for chemical and bacteriological work, but also rooms and apparatus for experiments in methods of drying, frying, curing smoking and otherwise preserving fish, for extracting oils and separating stearin, for refrigerating, for testing the breaking strain of ropes

The work of the *Ibis* is of such a special and interesting description that a short account of it is appended

This institution has two main functions (1) The Orphanage proper, which is a ship moored in the Ostend-Bruges Canal and on which the boys are educated up to eleven years of age, and (2) the Home for young fishermen in training, which is on shore close by The orphanage ship *Ibis* is an old gunboat, purchased from the British Government some years ago and adapted for its present purpose Boys are admitted as soon as they are old enough to receive instruction often at the age of six years They remain on the *Ibis* until they are eleven From the latter age the boys go to sea in groups of from ten to twelve in one of the trawlers belonging to the Society which manages the institution Voyages are made of similar length and under similar conditions to those of ordinary commercial trawlers, and the fish caught is sold in the market in the usual way While on board each boy is under an obligation weather permitting to one hour s lessons per day Between voyages the boys return not to the ship, but to the Home on shore, where every opportunity is given to them to complete their professional training They stay with the Society until the age of fourteen or fifteen and are then engaged with readiness by the trawl-owners

In Scotland the education of the fishing community falls naturally under four heads Work in day schools, work in continuation schools, special classes for day-school teachers, and the work of the central navigation schools

In the Scottish code of 1886, navigation appeared as a possible optional subject of instruction in the upper senior classes as one of the subsections of elementary science In 1890 important changes were made, the effect of which was that although " naviga-

tion" disappeared as a distinct subsection in the curricula of the day schools, in reality the way was opened to a wider and more definite course in this subject. The statistics of pupils from Scottish day schools presented for examination in navigation, nevertheless, shows a considerable decline between the sessions 1892–93 and 1900–01; in the former year 532 were presented, of whom 369 passed, whereas in the latter year only 279 were presented, of whom 194 passed.

Cooking is also taught to boys of the fishing population. From 1900 to 1911 the Scottish steam drifter fleet increased from 70 to 794 vessels, each of which required a crew of eight men with a boy as cook. The question of good cooking on board fishing vessels is of paramount importance as being so intimately connected with the comfort and well-being of the men, who now spend a large part of the year in following the fishing. It is therefore satisfactory to learn that according to the last available statistics no less than 362 boys were undergoing a course of instruction in cookery in the day schools at the various Scottish fishing towns and villages.

The great majority of the students attending the continuation classes in navigation and seamanship in Scotland are adults. In 1909 the Board of Trade intimated that it proposed to make compulsory the possession of a certificate of competency by skippers and second hands on all steam drifters of 50 tons gross and upwards. The immediate result was an unprecedented demand for continuation classes for fishermen at centres all over the Scottish coast, and especially in the Moray Firth area. The number of continuation classes in navigation in Scotland increased from nine in the session 1908–9 to thirty in 1909–10, and to forty-six in 1910–11. "It says much for the ability and resource of Scottish teachers that these classes were in most cases conducted by head masters or teachers in seaboard schools."[1]

The chief difficulty to be contended with is that whereas the boy leaves school at fourteen years of age he is unable to sit for the second hand's certificate until he is nineteen. These five years form one of the most important and critical periods in his life; and the future development of continuation classes should be largely concerned with the provision of suitable instruction for young lads during that period. The special training of day-school teachers in navigation need not detain us, though it is not without importance, seeing that a trained teacher is almost invariably a more successful instructor in navigation than a retired seafaring man.

[1] Departmental Committee on North Sea Fishing. Report, Part I, 1914, p. 121.

CHAPTER XI

SCIENTIFIC RESEARCH AND THE SEA FISHERIES

FOR centuries biologists have investigated the fauna and flora of the sea, and since fish form the most important constituent of the fauna we have a lengthy series of treatises on the subject commencing with Aristotle (384–322 B C) Until comparatively recently, however, monographs on marine fishes were for the most part systematic, i e the characteristics by which the various species might be distinguished from each other were fully described, whereas the biology, i e the life history and habits was neglected Modern ichthyological research may be said to date from the investigations of G O Sars, a Professor at the University of Christiania To him is due, in 1864, the credit of the discovery of the pelagic nature of the eggs of marine food fishes (with a few notable exceptions) He found the ova of the cod and other members of the cod family in the sea in the vicinity of the Lofoten Islands These eggs were small, round, transparent, jelly-like bodies floating in the upper layers of sea water Sars collected them by means of a fine meshed net of silk or muslin, transferred them into jars of sea water, where he was successful in keeping them till the young fish hatched out He also obtained ripe eggs from the body of the adult female, and proved it was possible to fertilise them artificially by milt taken from the male of the same species This remarkable discovery of Sars has since been confirmed and extended to the eggs of other valuable marine food fishes In fact, it may be stated that, broadly speaking, with the notable exception of the herring, the eggs of all our important food fishes have buoyant pelagic eggs of the nature above indicated The eggs of the herring, on the contrary, are heavier than salt water, and consequently sink to the bottom, where they undergo their development The extreme importance of this solitary discovery may be realised when it is stated that twenty years afterwards it was freely stated by many witnesses (fishermen and others) before the Royal Commission of 1885 that the eggs of marine food fishes were to be found on the bottom of the sea, where they were subject to extensive destruction by the trawl Since these eggs were in

reality pelagic it follows that no damage could be done to them by the trawl.

Many other observations having direct bearing upon important fishery problems were made from time to time by independent investigators, but it was not until the year 1870 that the value of co-operation in fishery research was practically recognised.

Fishery investigations are naturally expensive to carry out. Not only are specially equipped laboratories on shore desirable, but a sea-going steamer provided with nets and other suitable apparatus for the capture of fish and other marine organisms is an absolute necessity. Consequently a body of investigators working together under the control of a University, or a Government Department, or a special Commission or Committee is much more likely to produce results of value than a number of isolated individuals working with inadequate funds. In 1870 the " Royal Prussian Commission for the scientific investigation of the German Seas " was established. This Commission has worked continuously up to 1914, since 1902 in connection with the representatives of other nations in a scheme for the joint exploration in the interests of the sea fisheries of the hydrographical and biological conditions of the Arctic Ocean and the North and Baltic Seas.

Next in sequence comes the Scottish Fishery Board. Established as " The Board of British White Herring Fishery " in 1808, it was reconstituted in 1882. Shortly afterwards systematic scientific investigations were developed—they had been rather spasmodic previously—and in 1896 a special steamer (the *Garland*) was purchased to carry on the work.

In Ireland State-aided research is of more recent origin. The provisions of the Agriculture and Technical Instruction (Ireland) Act of 1899 enabled scientific research to be placed on a firm basis. Previously the investigation of marine biology in Irish waters had been undertaken by the Royal Irish Academy, and later by the Royal Dublin Society.

In England, the Central Authority (the Board of Agriculture and Fisheries) had until recently no funds placed at its disposal for the prosecution of scientific work on fishery problems. In the Estimates for 1910–11 a sum of £8,240 was placed at the disposal of the Board for the conduct of the English share of the North Sea International Fisheries Investigations (p. 245). Previously the English share of the work had been carried out by the Marine Biological Association.

The local authorities—the District Fishery Committees—have for the most part undertaken no scientific work. To this statement

there are, however, two notable exceptions—the Lancashire and Western, and the Northumberland Committees

Reference to the scientific work done by the local fishery committees will be found in the reports of various Government and departmental committees of inquiry The Committee of Ichthyological Research stated in 1902, "The (scientific) work performed by the Committee for the Lancashire and Western District under the chairmanship of Mr John Fell is particularly noticeable The Committee has published among other papers, eleven annual reports on its scientific work and certain valuable monographs In addition to these local researches, the Lancashire County Council has instituted laboratory classes for fishermen, and has, for some years, circulated in the county a travelling fisheries museum" With regard to Northumberland the Committee of Ichthyological Research report, "A laboratory and marine station has been established at Cullercoats, in the Northumberland Sea Fisheries District, mainly owing to the assistance given by Mr John Dent, a member of the local committee Experimental trawlings have been carried on for ten years, and some valuable experiments with regard to the practicability of fertilising fish ova at sea have been made" Similarly the Committee on Fishery Investigations (1908) referred in an appreciative manner to the scientific work of these two local committees

Subsequent committees of inquiry have been much less sympathetic towards the research work of local fishery committees The Departmental Committee on Inshore Fisheries (England and Wales), 1914 state "We are aware that the arrangements above outlined will make it quite impossible for committees as such to carry out scientific investigations"

In the year 1899 the Swedish Government invited the Governments of Germany, Denmark, Great Britain, Holland, Norway and Russia to send delegates to a Conference at Stockholm, which was called together "to elaborate a plan for the joint exploration in the interests of the sea fisheries of the hydrographical and biological conditions of the Arctic Ocean and the North and Baltic Seas" A subsequent conference was held, and the British Government was induced to enter into an arrangement with the other countries for the exploration of the North and neighbouring seas in the interests of the fisheries A permanent International Council was established consisting of two representatives of each participating nation, and it was decided that the central office of the Council should be at Copenhagen, and that there should be a central laboratory at Christiania When the International Council was assured of an annual subsidy it set to work along three main lines —

(1) The study of hydrographical conditions.

(2) The investigation of the biological conditions of the seas.

(3) The solution of the problem how far the deep-sea fishery as a commercial industry stands in general on a rational basis; whether the quantities and consumption of fish taken from the North and neighbouring seas are in a proper proportion to the production occurring under the prevailing natural conditions, and whether any disproportion arises from a general or local overfishing, or from an injudicious employment of the fishing apparatus at present in use.

For this work each country agreed to provide a special steamer with the apparatus necessary for marine research, and to furnish and maintain one or more laboratories where the observations and collections made on board the steamers might be worked out in detail. For the better investigations of these problems, Committees of the International Council were appointed at a meeting held at Copenhagen in 1902.

A committee of experts had the question of hydrographical observations for consideration, another dealt with the migrations of the most important food fishes of the North Sea, especially the herring and cod, still another was concerned with overfishing, and there was one for the fisheries of the Baltic. The responsibility for the British share of the investigations was entrusted to the Fishery Board in Scotland, and the Marine Biological Association in England, each of these bodies being voted a sum of £5,500 for the expenses of the investigations. In 1910 the latter body transferred its work to the Board of Agriculture and Fisheries.

The undertaking for these international researches was in the first place for a period of three years only, a sum of £42,000 being voted by the British Government as their contribution to the expenses of the investigations. At the termination of the period of three years the Government were induced to participate for a further two years; eventually the investigations tended to become permanent.[1] To give a brief account of the results of the investigations of the above organisations would be to write a voluminous text-book on marine biology and hydrography. The most that can be attempted here is to summarise the facts of more practical interest to the fisheries.

Although the international investigations have led unquestionably to an enormous increase of our knowledge of the marine biology and hydrography of the North and neighbouring seas, it can hardly be said that the fishery recommendations of the International Council have been of fundamental or far-reaching importance.

[1] The outbreak of war in 1914 necessarily meant the suspension of this work.

The hydrographical work may conveniently be considered first, though it is only of recent years that its importance from a fishery standpoint has been recognised This work, which deals with the physical and chemical properties of sea water, first came into prominence as a result of the famous "Challenger" expedition For the present purpose it is sufficient to consider the constitution and movements of the water of our northern seas As will be gathered from the preceding chapters, the British sea fisheries are carried on in the waters of a submarine plateau, which forms a part of the European continental shelf Most of this shelf underlies the seas of North-Western Europe, where the depth is not more than 100 fathoms The characters which are of importance in tracing the movements of large masses of sea water are the temperature, salinity, density and the gaseous contents, these latter being principally oxygen, nitrogen, carbon dioxide and sulphuretted hydrogen The determination of these characters, and particularly the temperature and salinity, simultaneously over large areas at regular intervals is one of the chief features of the hydrographical work of the international council

Samples of water are, therefore, collected on the research steamers, provided by the various Governments The instrument employed is the Pettersen-Nansen water bottle, which affords a very good means of obtaining representative samples of sea water from various depths The "bottle" consists of a number of concentric cylinders of a non-conducting material, ebonite These cylinders enclose a central space in which a deep sea thermometer is placed The bottle is lowered to the required depth in an open condition and then closed by means of a messenger, a weight which slides down the wire to which the bottle is suspended Both the central and the concentric cylinders are consequently filled with water from the depth to which the bottle was lowered, and as the loss of (or gain of) heat is practically negligible during the time taken to haul in the bottle, the thermometer in the central chamber gives the temperature The water is then carefully run off and bottled for subsequent examination at one of the shore laboratories The determination of the salinity is one of the most important subsequent examinations An estimation of the halogens present is made by precipitating these substances with nitrate of silver The total solids in solution are then calculated by means of hydrographical tables, and the salinity is expressed as the weight of solid saline matter per thousand grammes of water By means of these hydrographical observations it is possible to determine the movements of large bodies of water, and for the details of the results already obtained the original treatises should be consulted

Only a few instances of the possible connection of the fisheries with the salinity of the sea water can be given here. The summer herring fisheries of the British Isles commence in May off the outer Hebrides and the Orkneys. In June the fish are found off the coast of Aberdeenshire; further south in successive months. There is reason to believe that the movement of these herring is connected with the movement of bodies of water of certain definite temperature and salinity, but the connection has by no means been proved. The anchovy fisheries of the Zuyder Zee are probably influenced very largely by variations in the hydrographical conditions, and the arrival of the winter herring off the Norwegian coast coincides with the appearance of the so-called "bank water" of medium salinity and high temperature. The cause of the water movements in the North European seas is to be sought for in the fluctuations of the Gulf Stream. This Gulf Stream circulation undergoes an annual or, at any rate, a periodic contraction and expansion, which affect not only the fisheries, but the climate of these islands. This pulsation of the Gulf Stream has been investigated by the international commission. In addition to the Gulf Stream water there are two important constituents of our northern seas, the cold bottom water from the Arctic and fresh water from the rivers; but of the three the first is by far the most important.

The biological side of marine investigations now demands our attention. Organisms in the sea—whether animal or vegetable—may be divided into three groups, according to their mode of life: drifters, swimmers and fixed organisms. To the drifters the technical term "Plankton" is applied. The plankton consists for the most part of microscopic animals and plants which float about at the mercy of wind and tide. To the group of swimmers (Nekton) belong fish and marine mammals, which are capable of moving against the tide. To the fixed organisms (Benthos) belong creatures like oysters, mussels and "sea-lilies." Upon the microscopic plants of the plankton all marine life ultimately depends, since they alone can manufacture organic from inorganic materials, so it will be seen that the determination of the constituents of the plankton and its seasonal variation is of considerable importance. Many pelagic fish, e.g. the herring, sprat, mackerel and pilchard or sardine are direct plankton-feeders, while other fish, the demersal group to which the flat-fish and cod family belong, are only indirectly dependent on it. The plankton-feeders possess comb-like structures —the gill-rakers—attached to the gills, and these structures act as food strainers.

For the purposes of respiration water is taken in through the mouth and passed out over the gills, and during this process the

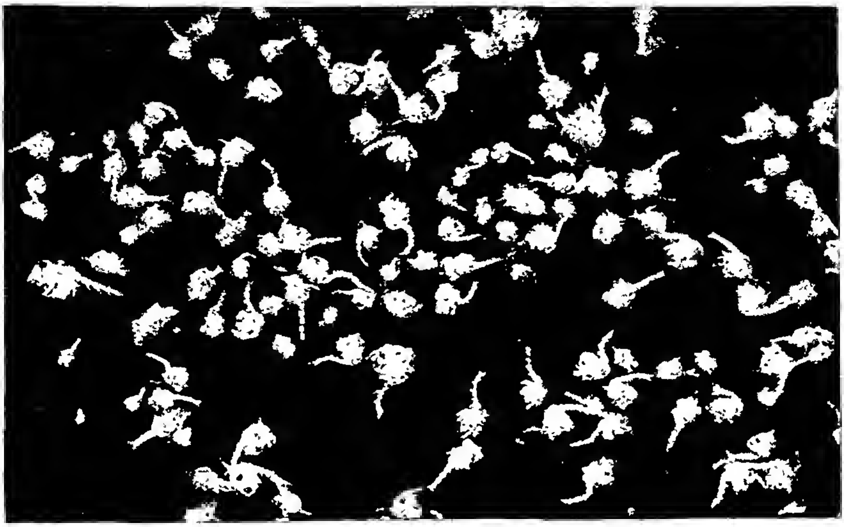
minute organisms of the plankton are retained by the gill rakers, whence they are washed off by the fish's tongue and swallowed

The constituents of the plankton are now well known the organisms have been identified and described, and of recent years more or less successful attempts have been made to determine by quantitative methods and chemical analysis the productivity of the sea and the food value of the planktonic material Nearly all forms of marine life are represented in the plankton at some stage or other of their life history Fish are only found in their young and helpless stages as eggs or larvæ Later in life, fish belong to the Nekton Crustacea form one of the most important groups of the plankton, some of them being represented in both their young and adult stages, others in the larval form only There are huge swarms of small crustacea known as Copepoda (lit oar footed), which are the most abundant of all animals in the sea These creatures form the main source of the food of pelagic fish, such as the herring Crabs and lobsters are represented in the plankton in their larval free-swimming stages only, during which a remarkable developmental metamorphosis is undergone The adult settles down on the bottom and then ranks among the Benthos

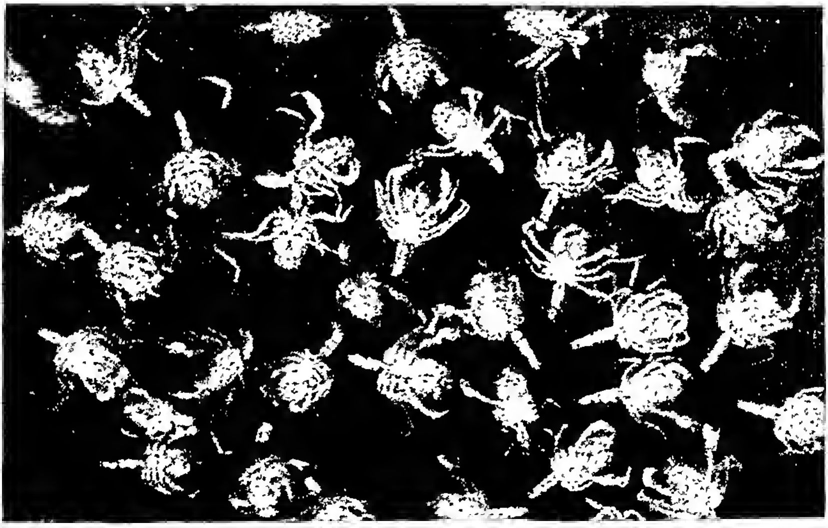
Molluscs only appear in the plankton in their larval period, a statement which is only strictly true as regards edible species There are large groups of molluscs which are planktonic animals for the whole of their lives, e g the Heteropoda and Pteropoda, but oysters, mussels, cockles *et hoc genus omne* belong during their adult existence to the littoral Benthos These edible bivalves produce eggs which are fertilised in the sea water The eggs while floating about develop into a larva quite unlike the parent Finally the larva settles down on the bottom and joins the sedate community of the Benthos

Marine worms for the most part are only found in the plankton during their larval existence, but there are a few groups which are entirely pelagic The starfish and sea urchin group (Echinodermata) all live on the sea bottom, but their larvæ are found in the plankton

The jelly fish, medusæ and other members of the Cœlenterates also belong to the drifters Finally there are a large number of unicellular forms Some of these are clearly animal, others no less clearly vegetable while still others are of doubtful position in the organic world So numerous are these creatures in the sea that it is no exaggeration to say that every drop of sea water at the surface contains some form of life The chief animal forms belong either to the Infusoria, the Foraminifera or the Radiolaria The two latter groups are well known, since their shells form the deep-

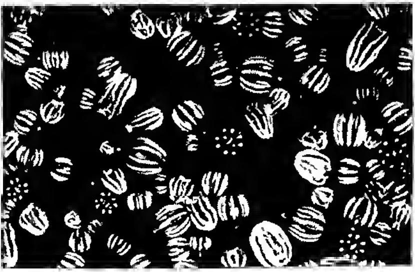


(*a*) THE FIRST LARVAL STAGE OF THE CRAB.
(*Zoëa*).



(*b*) THE SECOND LARVAL STAGE OF THE CRAB.
(*Megalopa.*)

(c) FIRST LARVAL STAGE OF THE BARNACLE
(*Nauplius*)



SMALL JELLY FISH
(*Pleurobrachia* and *Beroe*)

sea deposits known as the Globigerina and Radiolarian oozes. Of the plant organisms the most important undoubtedly are the Diatoms. The great producers of organic matter in salt water, they have been called the " pastures of the sea." Like the Globigerina and Radiolaria their accumulated shells form important deep-sea deposits.

The plankton is collected for examination by means of fine-meshed nets, known as tow-nets, because in their original form they were towed horizontally through the surface layers of water. The net-substance was either muslin or silk bolting cloth. Recently attention has been directed to the accurate estimation of the quantity of plankton in a given volume of sea water, and for this purpose several special nets have been devised, the original, and even now the most successful, being that of Hensen. This net, in the form of an inverted truncated cone, is lowered vertically to a given depth, and then raised to the surface perpendicularly. By this means a cylindrical column of water filters through the net and its planktonic contents are captured. The volume of this cylindrical column of water can be calculated, since the depth to which the net is sunk and the area of the net-opening are both known. The first and most important requirement of the Hensen net is that it should capture the whole of the plankton in a known volume of water. The correct estimation of the volume of water fished through is not a simple matter, since it is quite obvious that not so much water passes through the net as would pass through a ring of equal diameter to the mouth of the net, which had nothing attached to it. It is also clear that a square centimetre of the net would let through more water if it were composed of a single mesh than if, as is actually the case, it is composed of a large number of meshes, each bounded by a square of silk fibre. The filtration capacity of each separate net has to be calculated, and for the details of these calculations the original papers of Hensen should be consulted.

If we assume that it is possible to fish out all the plankton from a known volume of sea water, it becomes possible to determine the productivity of the sea and compare it with a similar area of land surface. The estimation of a catch of plankton may be made in one of four ways. The estimation may be by volume, by weight, by chemical analysis or by enumeration of the individual constituents. The method of chemical analysis enables us to compare the pastures of the sea with the pastures of the land. Chemical analysis of the plankton consists in the estimation of carbon hydrogen and nitrogen by organic combustion. The fats are determined by making ether extracts. The ash, chlorine and silica are also usually estimated.

The results obtained by Brandt, who developed this method, show that the autumn and winter plankton of the Baltic takes a position intermediate between rich pasture and lupine —

	Albumen	Fat.	Carbohydrates	Ash
Rich pasture	20 6	4 5	64 6	10 1
Autumn plankton	20 2–21 8	2 1–3 2	60–68·9	8 5–15·7
Lupine	20 6	2 6	72 0	4 6

A group of Infusoria, known as the Peridinians, resemble good grass hay or rye straw —

	Albumen.	Fat	Extracts free from N	Cellulose	Ash
Rye straw	3 5	1 5	38 8	51 3	4 7
Peridinians	13 0	1 3	39	41 5	5 2
Good grass hay	13 6	3 2	48 2	26 8	8 2

On account of their comparatively large amount of albumen, the Peridinians resemble the better kinds of fodder, but their small amount of fat and large amount of cellulose causes them to resemble the poorer sorts With the approach of spring a remarkable change occurs in the plankton, the percentage of silica becoming much higher, owing to the sudden increase of diatoms In order to compare diatoms with land plants the weight, free from ash, must be taken —

	Albumen	Fat	Carbohydrates
Very good lupine	29 3	2 8	67 8
Pea seeds	27 2	2 3	70 4
Diatoms	28 7	8 0	63 2

Compared with whole land plants, i e excepting special parts, such as rape seed, the percentage of fat in diatoms is invariably found to be much higher, the albumen is also relatively high On account of the high percentage of fat and albumen and the poverty of carbohydrates, diatoms exhibit a marked contrast to most land plants It must not be forgotten, however, that more than half the total weight of diatoms consists of silica, which contains no nourishing properties

In the summer plankton the animal constituents come into prominence, so that it is no longer possible to compare the analyses with land plants The albuminous constituents now predominate, fats may be either high or low, carbohydrates are comparatively very low

An interesting comparison has been instituted between the Copepoda and certain fish and edible mollusca The comparison is not so exact as that between the plankton and land plants,

because in the case of the Copepoda and the mollusca the carbohydrates must be to some extent contained in the alimentary canal; the shells and carapaces of the molluscs and crustacea are not included. For albumen the Copepoda closely resemble the oyster and mussel, while for fat, Copepoda, crabs, lobsters, oysters and mussels all come close together.

Since it is possible to estimate the amount of plankton produced for a given area of the sea by the volumetric or gravimetric determinations of the catches of the Hensen vertical plankton net, and since it is also possible to express this plankton in terms of foodstuffs, we can institute a comparison between the productivity of the sea and the land. According to Hensen the total annual production of plankton per square metre of the Baltic is 150 grams, while Biebahn and Rodewald estimate the productivity of cultivated land as equivalent to 179 grms. of dry organic substance per annum. The fertility of the sea is according to this estimate about 20 per cent below that of cultivated land. But when one considers what an enormous extent of land is incapable of cultivation it may be reasonable to assume that the produce of the sea in organic substance compares favourably with the land. The yield of the sea may be vastly different in different latitudes. On land it is well known that the tropics produce far more luxuriant vegetation than the frigid zone. He who has to force a path through the dense vegetation of a primeval tropical forest, and subsequently sees the stunted vegetation of Spitsbergen barely emerging from the soil, is easily convinced of the contrast.

In the sea it is exactly opposite. While it is true that there is a greater variety of form and colour among marine plants and animals in the tropics, there can be no question that the amount of life is greatest in the colder seas. All the great fisheries of the world have been prosecuted in cold and temperate seas; the banks of Newfoundland, the cod fisheries of Norway, and the great trawling grounds of the North Sea are examples that will occur to everyone. But the absence of fisheries in the tropics might conceivably be due to the apathy, indolence and lack of courage of tropical man. There is, however, definite scientific evidence that the productivity of tropical seas is less than that of Arctic seas. Hensen's method has been tried in the waters of Greenland and the Mediterranean, in various parts of the Atlantic Ocean by the Plankton Expedition of 1889, by the author in the Bay of Bengal, and in numerous other localities; in all cases larger hauls of marine organisms are made in the cooler waters. The largest on record are those of Vanhöffen in Karajak-Fiord, Greenland, while of numerous hauls made in the Baltic during the years 1889–93 only one was as small as the

average from the Sargasso Sea Similar methods of fishing in tropical and Arctic waters yield strikingly different results The hauls made in the Bay of Bengal by the Government trawler *Golden Crown*,[1] were far inferior in quantity to those of similar vessels working in the cold waters of Barents Sea, though in both cases virgin grounds were being exploited What is the reason for this difference ?

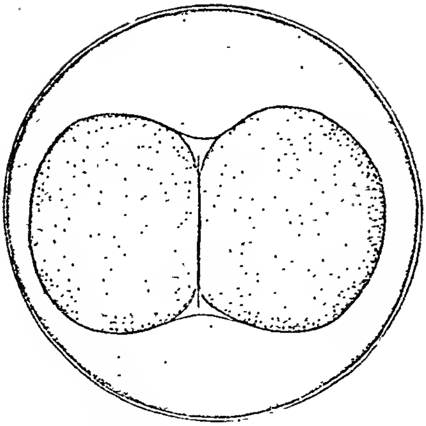
Briefly it is to be sought for in the destruction, or rather the reduction, of nitrogen compounds which goes on in tropic seas The ultimate source of the nitrogen of organisms is atmospheric air In nature the inorganic compounds containing nitrogen are present in three forms, ammonia, nitrates and nitrites No plant can develop without inorganic nitrogen compounds, and as all animal life is dependent on plants, it follows that all life on the earth or in the sea is ultimately dependent on the presence of these nitrogen compounds To trace their circulation is, therefore, of some interest By the action of atmospheric agents the nitrogen compounds of the land are gradually being washed out of the soil, and by means of the rivers into the sea The replenishment of the soil is carried out by the fixation of nitrogen from the air by means of nitrifying bacteria

There are in the sea bacteria which perform the reverse operation, that is, reduce the nitrates, nitrites and ammonia and set free nitrogen from these compounds, these are called denitrifying bacteria

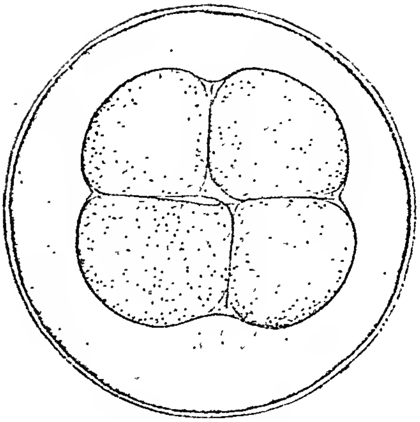
Now bacteria flourish best at a certain temperature In the case of these denitrifying bacteria, the temperature of tropical seas suits them better than that of the colder seas, and consequently the destruction of nitrogen compounds goes on to a much greater extent in the former waters It is certain that but for the action of these denitrifying bacteria, the waters of the ocean would long ago have been poisoned by excess of nitrogen salts derived from the waste of the land As a practical instance consider the enormous amount of sewage which is annually turned into the seas around our coasts, most of it in an absolutely crude condition What happens to this sewage ?

It is seized upon by these bacteria, and nitrogen compounds are prepared from it The nitrogen compounds are used up by the planktonic plants, such as the diatoms, these in turn are devoured by the crustacea of the plankton, such as the Copepoda The Copepoda are consumed by the herring, and the herring by man

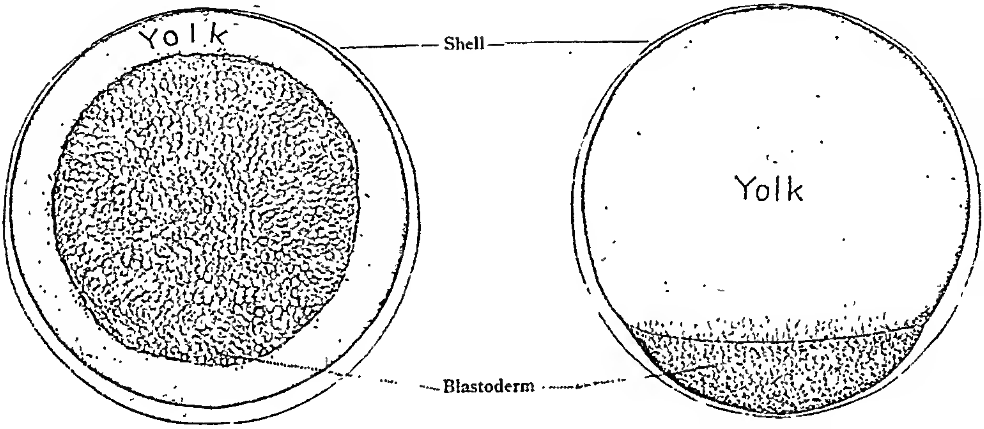
[1] See *Records of the Indian Museum* Vol VII 1912 Observations on the shallow water fauna of the Bay of Bengal made on the Bengal Fisheries steam trawler *Golden Crown* 1908–9 by J T Jenkins



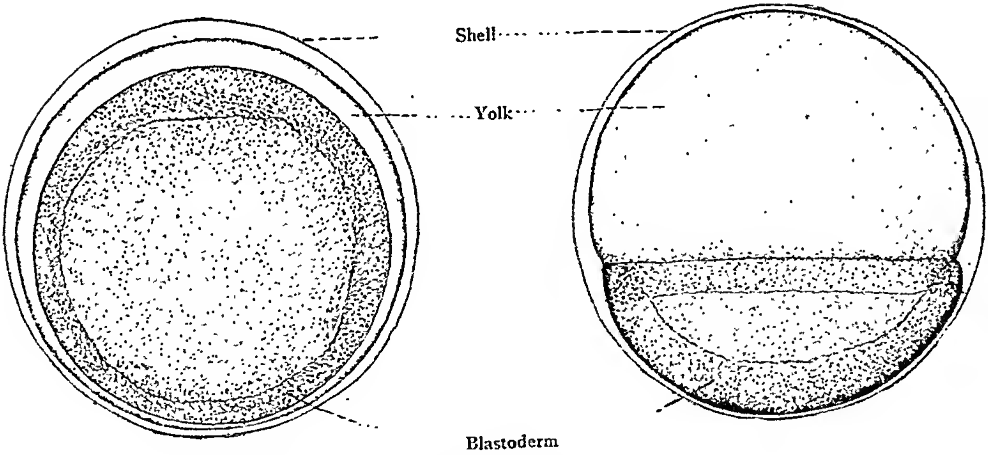
Flounder Embryo—3 hours.



Flounder Embryo—4 hours.

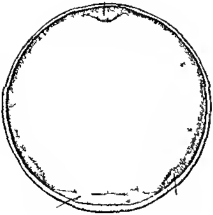


Flounder Embryo—$1\frac{1}{4}$ days.

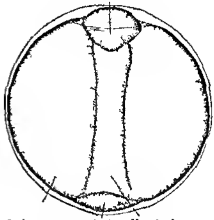


Flounder Embryo—$2\frac{1}{4}$ days.

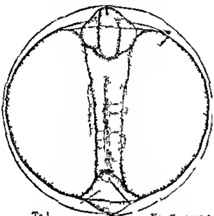
STAGES IN THE DEVELOPMENT OF THE FLOUNDER. I.



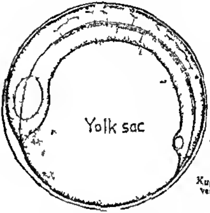
Flounder Embryo—3½ days



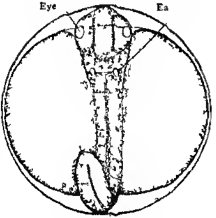
Flounder Embryo—4½ days



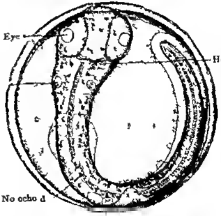
Flounder Embryo—5½ days



Flounder Embryo—5½ days



Flounder Embryo—6½ days



Flounder Embryo shortly before hatch ng

STAGES IN THE DEVELOPMENT OF THE FLOUNDER II

And so the cycle runs on. That man can break the continuity of this cycle by removing all the fish from the sea is obviously impossible, but he may interfere with it to such an extent as to make the results unpleasant to himself, and many examples are to be found of the evil effects which have followed in the case of land animals and plants from ill-considered and excessive destruction of life.

Another important branch of planktonic investigation is the study of the distribution of the eggs of marine fish, which in the spring months of the year form an important constituent of the plankton. Towards the end of the year most of our adult and sexually mature food-fish move out from the coasts into relatively deep water for spawning purposes. The details of these migrations and the depths at which spawning takes place are different for the various species. At one time it was thought that spawning took place on shallow banks or even close inshore, but this is now known to be incorrect, except in the case of the herring, which has demersal eggs. Except in a very few cases, such as the sharks and dog-fish, there is no sexual connection between the adult fish at the spawning season. The genital products, both ova and spermatozoa are shed into the surrounding water, where fertilisation takes place. Before development can proceed it is necessary that each egg should be fertilised by a spermatozoan, and probably the ovum exerts some attractive influence over the sperm. The fertilised egg undergoes its development while floating in the upper layers of sea water, and during this process is entirely at the mercy of wind and tide. The pelagic egg is minute (varying from 1/32 in. in diameter in the case of the solenette to 3/16 in. in the halibut). All pelagic fish eggs have some features in common. There is a non-calcareous shell and the contents are divisible into two parts; the living substance or germinal disc, and the yolk upon which the developing embryo feeds. The rate of development varies with the temperature, at a high temperature development is more rapid. In the Baltic it has been shown that the development of the egg of the flounder proceeds when the temperature of the surrounding water is below the freezing point (0°C), the actual temperature at which it commences being minus 1·6 C. The author has taken these eggs in the Baltic when the steamer had to be put astern to break the ice, so that the tow net could be lowered. At the commencement of the season the larvæ of the flounder are hatched in eleven days, but later in the spring when the weather is warmer six days are sufficient. When hatched the young fish carries a relatively enormous bag—the yolk sac—on its ventral surface. This bag contains the remains of the yolk on which the young fish continues to feed for several days. When the yolk is absorbed the larva

feeds on the surrounding plankton An estimation of the number of fish eggs and larvæ present in a given area of sea water is possible by Hensen's method, and other interesting deductions may be made The first calculations of this kind were made in the West Baltic for cod and flat-fish (plaice) Hensen concluded that for the Ecken forde waters, where the fishery for cod and flat-fish is carried on in an area of about 16 sq miles, there are in January an average of 30, in February from 45 to 50, in March at least 60, and in April 50 floating eggs of those species per square metre of surface, with an average depth of 20 metres These eggs take on the average fifteen days to develop under the conditions obtaining in the West Baltic, so that the numbers given above must be doubled in order to give the number occurring per month under a square metre of surface This gives from January to April 370 eggs The ratio of adult males to females in these species is known, as is the average number of eggs produced by a female fish, and the statistics of the commercial fishing are also on record From these data Hensen calculated that the number of cod and plaice annually caught by the Eckenforde fishermen would, if allowed to remain in the sea, have produced 23 400 million cod and 73 895 million plaice eggs yearly These numbers, which are calculated from a nine-year average, give for every square metre of the 16 sq miles of sea fished over 266 cod and 84 plaice eggs, a total of 110 6 This added to the 370, calculated above, gives a total of 480 6, which represents the number of eggs that would have been produced from all cod and plaice captured and free, annually for each square metre of surface Consequently 110 6/480 6 or 1/4 4 gives the fraction of cod and plaice actually captured per annum, or, in other words, man captures for his own use every year about one fourth of the total number of adult fish in this particular area in the West Baltic, a result which is strikingly confirmed for other areas by the fish marking experiments described below If these data are correct, it is obvious that considerable depletion of the fishing grounds can take place in certain restricted areas The estimation of the number of floating fish eggs according to this method has important practical bearings It becomes possible to compare the fertility of other regions with this area of the West Baltic, and so obtain some idea of the probable annual catch of fish The results for the North Sea invariably gave a greater number of eggs, and the open ocean invariably a less number than the West Baltic

During recent years successful investigations have been made into the migratory habits of marine fish [1] The method employed is to mark certain species of fish with numbered labels, and up to

[1] For a general account see *The Migrations of Fish* by A Meek London 1916

the present the greatest success has been obtained with the salmon, the plaice, the eel and the flounder. The marking experiments with eels[1] have been for the most part carried on in the Baltic by Danish investigators; those with flounders in the same sea by German scientists, but salmon and plaice marking has been extensively carried on in Northern Europe. The results of marking eels in the Baltic prove that the migration of the adult is a seaward one, since in every case the recaptured fish were taken nearer the open sea. The rate of migration was about 15 kilometres per day on the average, and that for consecutive periods of from 17 to 30 days. In individual cases eels moved 367 kilometres in 29 days, and up to 1200 kilometres in 93 days, that is 745 miles in about three months. This particular eel was liberated at Tvarminne, in Finland, on the 15th August, 1905, and recaptured on the east coast of Jutland, near Helgenaes, on the 16th November in the same year.

The eel marking experiments were part of an extensive investigation into the life history of this fish, undertaken mainly with the object of solving the mystery of the spawning.

It has been known for centuries that young eels—elvers—move up the rivers of Western Europe in spring, and large adult eels move down these rivers in autumn to the sea. These large eels have a silvery appearance and are known, on the Continent, at any rate, as silver eels. As soon as they get to sea they are lost sight of; they disappear entirely in the North Sea and off the British coasts. In the Baltic, however, there is a regular fishery for these eels, which are caught in basket-like traps. The fish move parallel to the coast outwards through the Sound into the North Sea. Unless the traps are set with the openings in a certain direction no eels are caught, the path of the eels migration is, therefore, in the direction of the open sea. The marking experiments referred to determined the rate of progress of this seaward migration. Adult eels were never observed travelling in the reverse direction, so it seems extremely probable that the eel spawns once only in its life, and after spawning dies in the open sea. No one has ever captured a ripe female eel, and there can be little doubt that the eel spawns in the sea and only in the sea. In the spring enormous swarms of young eels are seen ascending the rivers of Western Europe, and these eels have the external characteristics of the adult. To get into lakes and ponds which are shut off from running water there is no doubt the eel makes short journeys over damp soil and grass. Until recently it was quite unknown in what part of the sea the eel spawned, and there was a serious gap in our knowledge between

[1] See "Contributions to the Life-History of the Eel," by Johs. Schmidt. International Fishery Investigations. *Rapports et Procès-Verbaux*, Vol. V, pp. 137–274.

the period of departure of the silver eel and the arrival of the elvers

The elver has long been known to develop from a totally distinct form—the Leptocephalus—a practically transparent little fish of the shape of an oleander leaf, and so named because it was originally thought to be a distinct species The Leptocephali were also thought (by Gunther[1]) to be abnormally developed forms, but eventually the French zoologist, Delage, succeeded in keeping a Leptocephalus for seven months in an aquarium at Roscoff and observing its transformation into a young conger In 1893 the Italian naturalists, Grassi and Calandruccio, traced the development of young eels from Leptocephali These naturalists were fortunate in obtaining large numbers of Leptocephali in the Straits of Messina, where strong currents bring them to the surface In other localities Leptocephali especially *Leptocephalus brevirostris* the young of the eel, were found very rarely It seemed very unlikely that the Baltic eels, for instance, were spawned in the Mediterranean

Part of the International Fishery investigations was directed to a systematic search for eel larvæ in Northern waters This search was facilitated by the accidental discovery of a single specimen of *Leptocephalus brevirostris* near the surface in the sea off the Faroe Islands by the Danish Governments investigation steamer *Thor*, in May, 1904 The sea was at this point over 500 metres deep

Schmidt, the Danish investigator, devised a careful survey off the west coast of the British Isles, and was successful in obtaining large numbers of eel larvæ The reason why these had never been found before is because the eel seeks great depths in the ocean, 1000 metres and more, for spawning purposes

These depths are not found in the Baltic, Skager-Rack or the North Sea The temperature at depths of 1000 metres is, at least, 7° C, that is higher than that encountered at the bottom of the North Sea The great plateau on which the continent of Europe is built up, falls away somewhat abruptly into great depths, and the 200, 500 and 1000 metres lines run fairly close together The 1000 metre line is nearest the shore off the coast of Spain, where it is only 15 miles distant The Leptocephali larvæ were taken on the *Thor* by a fine meshed net, which fished through the mid layers of water, and the greatest number were taken off the south west of Ireland, between 56° and 43° N Lat The temperature here at depths of 1000 metres was over 9° C all the year round Larvæ were obtained right along the 1000 metre line from the Faroes to

[1] *An Introduction to the Study of Fishes* Edinburgh A and C Black 1880 p 181

the North of Spain. They were also taken to the westward up to 15° W. Longitude, where the depth is 4000 metres and more. Eel larvæ are true pelagic forms, they are not found on the sea bottom, but only in the upper layers of water. At night they swim at the surface, in the daytime at depths of from 50 to 100 metres. The greatest number of larvæ taken in a single haul of the net was 70, at a depth of 70 metres in 49°25′ N. and 12°20′ W., where the depth of the sea is from 1270 to 1310 metres. All the eel larvæ taken in May and June were in a very early stage of development; it was only in September that a search for successive stages in the larval development was successful.

It is interesting to note that the later stages were captured nearer the coast. In the course of its metamorphosis the breadth of body of the eel larva diminishes, the eyes become a little smaller, the larval teeth disappear, the gut shortens, and gradually the eel-like appearance develops.

At first the young eel is transparent, the so-called Glass-eel stage. In the Baltic this stage is unknown, but in West Europe, in Great Britain, France and Spain it occurs in overwhelming numbers, and in many localities is the occasion of a regular fishery.

M. Vaillant, of the Paris museum of Natural History, has described this fishery on the Atlantic coast of France and there are other descriptions for the south of England and Spain. All agree in describing the enormous swarms of young eels and the brief duration of the fishery. The young eel now passes into a dark coloured condition, the so-called Montée. The nearer the coast is to the 1000-metre line the earlier the eels appear, and naturally at an earlier stage of their development. On the north coast of Spain, at Santander, Bilbao and San Sebastian; in Bayonne in the south of France, the Glass-eels appear from October to December; in France at Pauillac, Rochefort and Marans, which lie in the estuary of the Gironde and Charente, and in Ireland at Castlemaine, Tralee and Limerick, the fishery commences in January; in France at Nantes, Dinan and Caen, on the coasts of Brittany and Normandy, as well as in the English Rivers Parret and Severn, it begins in February and March.

By the time the young eels have worked their way through the North Sea they have for the most part passed through the Glass-eel stage, and have taken on a dark appearance (the Montée). A few Glass-eel larvæ have, however, been obtained in the sea off the Danish coast, but never in the Baltic. Here the stage is the Montée.

All the ascertained facts tend to show that the ripe fresh water eel is a deep sea fish, spawning out in the open Atlantic. The larvæ migrate to the rivers of Western Europe, where they live until

the approach of sexual maturity forces them to make the long migration to their native place

Flounder marking experiments have been carried on in the Baltic mainly by German and Dutch observers Off the island of Bornholm there is a fishing ground which in winter and spring is stocked with flounders either spawning or about to spawn The male fish predominates largely, forming about 70 per cent of the catch The male flounder, like the plaice, is appreciably smaller than the female, the smallest ripe male observed was only 5½ in in length, the smallest female being 6¼ in On this Bornholm ground 770 marked flounders were liberated by Strodtmann[1] in February and May, 1905 During the following summer nearly 5 per cent of these fish were recaptured, and in all cases near the coast in shallow water The records show that the shoreward migration only commenced at the close of the spawning season, and then proceeded with considerable rapidity One flounder travelled 40 miles in 13 days, another 70 miles in 18 days, that is on the average from 3 to 4 miles a day It was not found possible to establish a migration along the coast during the summer months In the Baltic, therefore, the flounder migrates from the rivers and estuaries in winter to the open sea, and in the late spring and summer makes the return journey During its stay in the sea it spawns and the larvæ are hatched there In the winter the young and immature fish are met in the coastal waters On the North Sea coast the complement to the above experiment was undertaken by Ehrenbaum,[2] who at the end of the autumn flounder fishery in the Elbe in 1905 and 1906 marked altogether 753 fish, and of these 35 were recaptured in the Elbe and 29 beyond it, together about 8½ per cent

Of the sixty-five fish returned, four were recaptured from other rivers than the Elbe, namely two from the Ems and two from the Weser From this it is suggested that the flounder, unlike the salmon, does not confine itself to one river This may be due to the fact that the river is the native place of the salmon, whereas the flounder is hatched in the sea Some of the other flounders which were recaptured in coastal waters, had wandered so far from the mouth of the Elbe as to render it highly improbable that they would have re-entered that river Fourteen were recaptured off the coast of Holland, indicating a tendency for a general migration in a westerly direction Probably the conditions for the spawning of the flounder, as well as for the plaice, are far more favourable

[1] Zur Biologie der Ostseefische von S Strodtmann. Mitteilungen des Deutschen See Fischerei Vereins Bd 22 1906

[2] Versuche mit gezeichneten Flundern oder Elbbutt (*Pleuronectes flesus*) von E Ehrenbaum Mitteilungen des Deutschen See Fischerei Vereins Bd 23 1907

in the south-western part of the North Sea than in the south-eastern, there being a greater depth of water and a higher salinity and temperature in the former region. Another interesting fact established by these experiments is that the flounder when on its seaward migration for spawning purposes takes no food, but utilises the material stored up in its tissues for the development of its reproductive organs, so that when the spawning period is over there is a decrease in weight of from one-fifth (in the males) to two-fifths (in females). The German results have been confirmed by the observations of Redeke[1] in the Zuyder Zee. Here no less than 514 flounders were marked and liberated; of these 284, or about 55 per cent, were recaptured. This high percentage is due for the most part to the fact that these investigations were carried out at the time when the local fishery was most active. As a rule the flounders marked by Redeke, like those of the Elbe, did not return to their original locality, one of the Zuyder Zee specimens wandering to the Meuse and another to the Seine. The general tendency was to the south-west. Up to the time these experiments were completed a far more satisfactory case for seasonal migration was made out for the flounder than for the plaice.

A considerable number of plaice have been marked and liberated in the North and Irish Seas. The label in general use consists of three parts, a bone button, an elliptical numbered brass disc, and a silver wire, and is affixed to the fish in the following manner:—

The fish is pierced through the fleshy part of the body, midway between the head and the tail, by means of a steel needle, the perforation being a little below the base of the dorsal fin; the wire bearing the bone button at one end is then pushed through the fish, the label is put on and a small loop made by means of round-nosed pliers and turned down on the label. The whole operation which sounds rather alarming, takes less than a minute; no blood is drawn and the fish apparently suffers no pain or inconvenience. The marked fish are kept for a time in tanks on board the investigating steamer, until they are seen to be in a thoroughly healthy condition. The mortality among marked fish prior to liberation is extremely small, certainly much less than 1 per cent. The co-operation of the fishermen, which is essential to the success of the experiments, is secured by offering a small reward for the return of a marked fish together with particulars of the date and place of recapture. As a general rule the fishermen return the marked fish willingly, but in some cases they are reluctant to do

[1] *Rapport over onderzœkingen betreffende de visscherij in de Zuiderzee ingest, i.d.j.* 1905 en 1906. H. C. Redeke. S'-Gravenhage (1907) Bijlage III, m. pl. 36 en 1, Kaartje.

so There is some reason for believing that off the Cumberland coast some of the inshore trawlers, thinking that the experiments had for their object the imposition of further restrictions on fishing, did not return marked plaice caught in their nets In the early days of the investigations the labels were frequently returned without the fish, and in one case the label bore unmistakable evidence of having been in the frying pan

The liberation of marked plaice in various parts of the North Sea was commenced in 1902, and continued each year until 1909 The results of the experiments made in the years 1904 to 1908 confirm and extend the earlier experiments, and as a result the main lines of migration of the plaice in the *southern* part of the North Sea may be regarded as established The most marked movements are (1) The migration of mature fish from the north to the spawning grounds in the southern part of the North Sea, where they assemble in December, January and February in the neighbourhood of Sandettie Bank and the Hinder, east and south of the mouth of the Thames, and (2) the return northwards of these fish during the spring and summer to the feeding grounds in the central parts of the North Sea

The southward autumn spawning migration is taken part in by young mature fish, especially males, from the nursery grounds off the Dutch coast, by similar fish from the shallow water of the German Bight, as well as by larger fish from the central parts of the North Sea, especially from the Leman Banks and Leman Ground, and the region west, south and east of the Dogger Bank A gradual movement of the larger immature plaice from the nursery grounds of the Dutch and German coast during the early summer into deeper waters to the west and *north* seems also to be established beyond doubt, whilst the English experiments off the Danish coast have confirmed the conclusions arrived at by Danish and German investigators, that a similar offshore movement of the immature fish takes place in summer, and further that there is a return migration of these fish in the following spring to shallow inshore grounds [1]

It seems fairly certain that small plaice undertake comparatively short migrations, and are generally retaken at no great distances from the place where they have been marked and liberated, whereas plaice of larger sizes often travel very long distances in a comparatively short *time* *There are* isolated instances of large plaice having travelled from the central areas of the North Sea to the western part of the English Channel

[1] For a bibliography of papers on the plaice marking experiments see *Report on the English plaice marking experiments* 1906–08 by G T Atkinson International Fishery Investigations Fourth Report (Southern Area) Cd. 6125, London, 1912

The marking experiments also give some indication of the great intensity of fishing on the North Sea grounds. Owing to the fact that many of the fish are injured in the trawl when they are caught, and hence do not survive after they have been marked and liberated and also to the fact that the labels used for marking appear to drop off the fish after about two years, the estimate of the intensity of fishing yielded by the experiments is a minimum one.

In some of the experiments in which special precautions were taken to mark only healthy and vigorous fish, the percentage returned within one year of liberation has reached 50 per cent.

In their Irish Sea experiments the Lancashire Committee endeavoured to obtain information on three points; the migration of the plaice, their rate of growth, and the intensity of fishing on the different grounds. In the case of individual fish remarkable journeys were performed. Of a batch of fish liberated off Blackpool two were recaptured on the east coast of Ireland, one in Courtown Bay the other at the Layton Coastguard Station. These fish must have travelled at least 130 miles in six months. In the case of another batch of fish marked and liberated in October in Beaumaris Bay, one was recaptured by an Ostend steam trawler, the *Jules Henri*, in 48 fathoms water near the coast of Waterford the following May, and another in the entrance to the English Channel by the Fleetwood steam trawler *Eulalia* the following September. In one case a fish was caught three times in a few months. It was first caught, marked and liberated near Morecambe Bay Lightship. Ten weeks later it was again caught by one of the Lancashire Committee's cutters in Barrow Channel, and returned to the sea alive. Hardly a month elapsed before it was again caught, this time by a Fleetwood fisherman. The intensity of fishing in certain areas off the Lancashire coast must be extremely high. On the other hand, some fish have only been recaptured after two years. A plaice marked and liberated off Walney Island was caught over two years later, eight miles south-east of the Bahama Lightship (off Ramsey Bay, Isle of Man). In another case a plaice marked and liberated off Llanrhystyd, in Cardigan Bay, was found two years afterwards only a few miles away at Llanon. In a third instance a plaice marked and liberated off Penkilan, in the county of Carnarvon, was recaptured after two years 3 miles west by north of the Barrels Lightship, Wexford.

In spite of many remarkable journeys, the plaice of the Irish Sea must be regarded as, on the whole, sedentary creatures. The Irish Sea is really comparable to a large lake with an indigenous fish population; and probably derives little by immigration from other waters, except in the case of certain pelagic species, such as

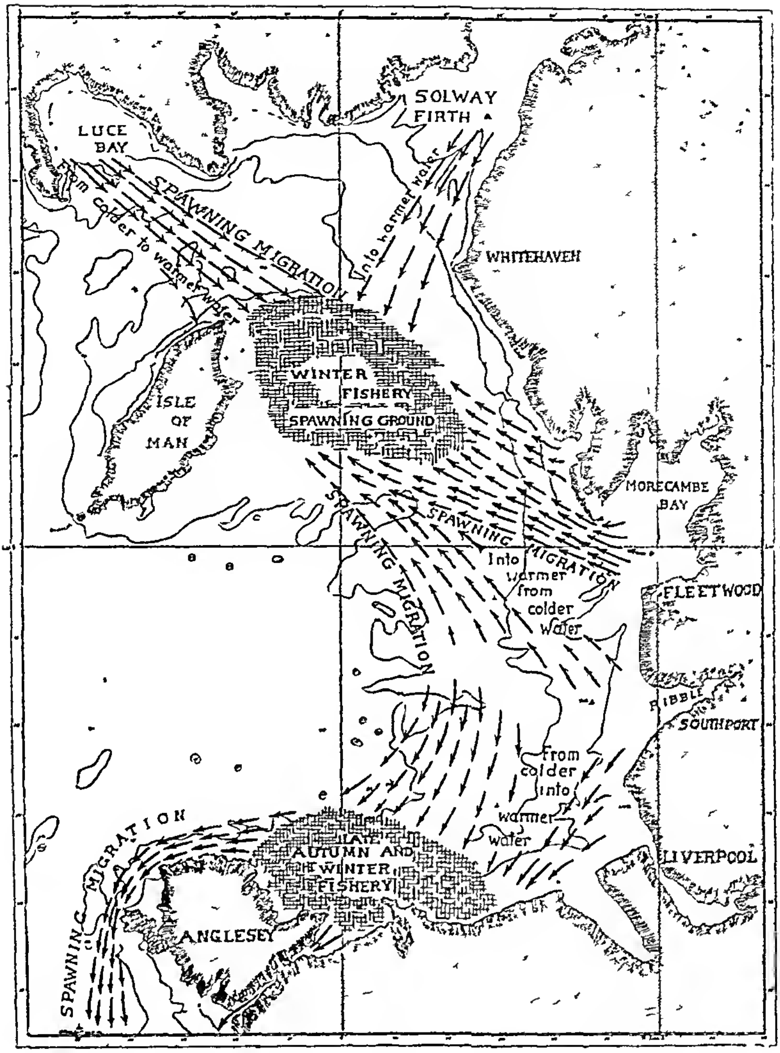
the herring and mackerel Even the herring is probably returning to its native place for spawning purposes

In the Irish Sea itself the percentage of recaptured fish is invariably high, e g in the Newcome Knoll (Mersey Estuary), experiment in November, the percentage returned was 40, off Blackpool, also in November, percentage returned 50, Morecambe Bay March percentage returned 47 Many other instances could be given, on the whole in the eastern portion of the Irish Sea from 30 to 40 per cent of the marked fish have been traced In Cardigan and Carnarvon Bays a far smaller proportion of the plaice were returned

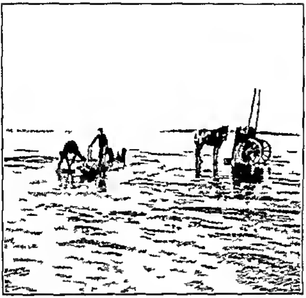
In the Irish Sea there is a broad distinction between summer and winter migrations, the former including those made from June to September, the latter from October to May In the summer months the larger plaice move from the shallow waters inshore to the deeper and cooler waters offshore The plaice fishery, which is carried on by the Southport half-decked cutters from Nelson Buoy off the entrance to the Ribble, down towards the Liverpool Bar and Northwest Lightships, is for fish which have moved out from the shallow waters of the channels and estuaries The winter movements of plaice below 10 in in length are mainly food migrations, or may be caused by the variations of the sea temperature along the coast These movements are alongshore, and follow no definite ascertainable order

Tho winter migrations of the larger plaice are almost certainly spawning migrations The only large spawning ground for this species in the Irish Sea east of the Isle of Man is to the north-east of Douglas, where there is a regular winter fishery The spawning plaice caught here by the trawlers have migrated outwards from Morecambe and Liverpool Bays, and to a less extent from the Solway, Luce Bay and the Firth of Clyde A large number of fish have been marked and liberated in Luce Bay, which is an area closed to trawling by the Scottish Fishery Board, and enough have been returned to show that the waters of this bay serve as a reserve area for mature fish, which move offshore to spawn in the early spring, when the sea temperature in Luce Bay is much below that of the deeper offshore waters

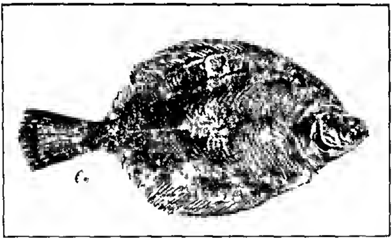
Another considerable winter plaice fishery exists in Redwharf Bay, off the North coast of Anglesea This generally lasts from November to January, when the bay is sheltered from the prevailing south westerly winds It is believed that the commencement and duration of this fishery depend on the temperature and other physical conditions of the sea water The fish marking experiments have thrown considerable light on the condition of this fishery It appears there are two main groups of plaice caught in Redwharf



MIGRATION OF PLAICE IN THE IRISH SEA.



COCKLING WITH THE JUMBO (MORECAMBE BAY)



A MARKED PLAICE

Bay, one with a mean length of 23 in., the other with a mean length of 29 in.

The former fish have been reared in the Lancashire "nurseries." The larger fish are those which have survived the intense summer fishery of the Liverpool and Morecambe Bay areas. All these plaice migrate into Redwharf Bay, when the sea temperature of the Lancashire waters falls below a certain point. The fishery in this bay terminates suddenly, before the stock of fish is exhausted, the fish moving round the coast of Anglesea to Carnarvon and Cardigan Bays, and even further south.

The larger plaice caught in Cardigan Bay in the first few months of the year have come from Redwharf Bay, and earlier still from Lancashire waters. The migration into Redwharf Bay is not for spawning purposes, since the fish spawn further south in deeper water, it follows that a large proportion of Lancashire plaice are spawned in Cardigan Bay and St. George's Channel, the larvæ being transported northwards by the Gulf Stream drift. Plaice marked and liberated in Cardigan and Carnarvon Bays move either towards the east coast of Ireland or the Bristol Channel. There is no record of a plaice liberated in the Welsh Bays moving up to the Bahama Bank area. Probably many of the migrations made by the Irish Sea plaice are simply attempts on the part of the fish to move about, so as to live under conditions as nearly uniform as possible.

Since all the plaice were measured before liberation and after recapture, an indication of the rate of growth has been obtained. A striking result is that the rate of growth in the winter is nil. From October to March there is practically no growth; it only commences in April and becomes most marked in June, July and August. The average annual increase in length is almost exactly 3 in., but this statement only applies to fish which were at the time of marking between 8 and 10 in. in length. The cessation of growth in the winter months cannot be connected with the spawning habit, since the majority of the fish marked were not spawners. It is more likely due to a great scarcity of food in the winter, and to a decrease of metabolism. The weight of a plaice of given length is always less in winter than in summer. Fish recaptured after two years had grown from 6¼ to 7¼ in. These fish after carrying the labels for two years were evidently none the worse, being plump and in good condition.

CHAPTER XII

STATE AID AND FISHERY RESEARCH

THE question of the organisation by the State of scientific research into problems affecting the sea fisheries of these islands is of paramount importance Properly to understand the present position, it is necessary to amplify the brief statement contained in the previous chapter It is unnecessary to recapitulate the names of the various organisations and authorities, international, national and local, engaged in this important work

The present position and future prospects can only be correctly appreciated by a slight historical retrospect

Since the commencement of the century no less than three Departmental Committees have inquired into, and reported on, the facilities for scientific research into questions affecting, or likely to affect the sea fisheries of the British Islands The first of these, known as the Committee on Ichthyological Research, was that appointed by the Board of Trade in 1902 In 1907 the then Chancellor of the Exchequer (Mr Asquith), appointed a Committee to " inquire into the scientific and statistical investigations now being carried on in relation to the Fishing Industry of the United Kingdom by the Fishery Departments of the Government, the Sea Fisheries Committees, the International Council for the Exploration of the North Sea, and the Marine Biological Association, and to report what work of this character is required in the interests of the Fishing Industry, and by what methods or agencies it can be most usefully and economically carried out in future " This Committee reported the following year, and is generally known as the Committee on Fishery Investigations of 1908

The third Committee was appointed in 1913 by the then President of the Board of Agriculture and Fisheries (Mr Runciman), to advise the Board on questions relating to the elucidation through scientific research of problems affecting fisheries This Committee issued its " first report " early in 1914 No second has appeared, or is likely to appear

It will be noted that the first two of the above Committees took cognisance of the fisheries problems affecting the whole of Great

Britain and Ireland; whereas the last Committee was concerned with scientific investigation in England and Wales only.

The reports of the first two Committees are now mainly of historical interest only, but some reference to their reports is, nevertheless, necessary.

When the Committee on Ichthyological Research reported, scientific research was carried on by the Central Authorities in Scotland and Ireland at the expense of the State. Both of these bodies were at that time carrying on, and have continued, investigations of the utmost value to their respective fisheries. In England and Wales the Central Authority was not provided with funds for scientific work, unless the collection of fishery statistics be so considered; the task of organising and directing research fell on the Marine Biological Association and certain of the local fisheries committees, the former body being the only one in England and Wales at that time in receipt of State aid in connection with fisheries work. The Committee on Ichthyological Research made a number of recommendations, of which the following are the most important. Provision to be made by the State of funds for the collection of statistics from trawlers, and the examination of material at the ports, for the provision of the necessary assistants at the marine laboratories already in existence, for the provision and maintenance of three research steamers, and for putting the staff in Scotland and Ireland on a permanent basis. They also recommended that statutory powers should be given to the local fisheries committees in England and Wales to expend money on fishery research.

Between 1902 and the publication of the report of the Committee on Fishery Investigations in 1908, a considerable advance was made by the State in the provision of funds for fishery research. The International Council referred to in the preceding chapter was established as the result of Conferences held at Stockholm in 1899 and Christiania in 1901. The total expenditure incurred by Great Britain up to 31st December, 1913, on the international fishery investigations amounted to £154,919, exclusive of the cost of printing the reports. In many other respects, the position of the various authorities engaged in fishery research was pretty much the same in 1907 as in 1902. The chief recommendations of the Committee of 1908 were the establishment of a Central Fishery Council for the United Kingdom, which should have the control of public funds for fishery investigations of a national and international character; the strengthening of the Board of Agriculture and Fisheries as the Central Fishery Authority for England and Wales, and the provision of additional funds to the Board for the encouragement of local work; the continuance to the Fishery

Board for Scotland of funds for local scientific research, the continuance of international co-operation in scientific and statistical investigations upon a definite and permanent basis, and finally the continuance of the annual grant of £1,000 to the Marine Biological Association of the United Kingdom The main difference between the position in 1908 and 1902 was that the Government were expending about £13,000 annually on the international investigations

One finds in the Civil Service estimates for 1907–8, under the heading of "North Sea Fisheries Investigation," the sum of £12,500, being the sixth instalment on account of expenditure in connection with the international scheme for investigating problems concerning the fisheries of the North Sea and adjacent waters In Scotland the agent of the Government for the purpose of these investigations was the Fishery Board, and in England the Marine Biological Association, to each of whom the sum of £5 500 was payable annually A sum of £1,250 was also paid annually as a contribution to the Central Bureau, which had been established at Copenhagen

The Board of Agriculture and Fisheries, the central authority in England and Wales, was ignored in the allocation of these grants This led to considerable friction between the Board and the Association, as will be seen from a study of the evidence given before the Committee of 1908 There can be no reasonable doubt that the Marine Biological Association carried on their work under great difficulties

Sir E Ray Lankester complained in 1906 that "no kind of assistance or even good-will had ever been received by the Marine Biological Association from the paid officials connected with fishery matters in this country" After much washing of dirty linen in public the Board ultimately gained the victory, and in 1910 they took over England's share of the international investigations

In 1909 the Development and Road Improvement Funds Act was passed According to the provisions of this Act the sum of £500,000 was to be allocated annually for five years for certain purposes, amongst which was the "development and improvement of the fisheries" Applications for funds for this purpose were to be made to the Treasury, who would refer the matter to the Development Commissioners for report The first annual report of the Development Commissioners (July, 1911) contains a solitary reference to fishery applications "In respect to the development and improvement of fisheries proper, the Commissioners have received no applications They learned some time ago that not inconsiderable applications for advances for such purposes had been

made to the Treasury, and referred to the Government Department or Departments concerned."

At this time applications from local authorities in England and Wales had already been at the Treasury for over twelve months. In accordance with the regulations prescribed by the Treasury the applications had been forwarded to the Board of Agriculture and Fisheries for consideration and report, and it is here that a delay of over twelve months occurred. Meanwhile, in answer to repeated questions in Parliament, the Board returned replies which were invariably evasive, and occasionally inaccurate.

The fact is the Board of Agriculture and Fisheries were quite unprepared with a scheme for the development of the fisheries, and they deliberately delayed schemes prepared by the local authorities so that they might prepare and submit their own scheme first. Meanwhile, they had the opportunity of collecting ideas from the schemes already submitted to them for report.[1] In one instance a scheme submitted by a local authority in May, 1910, was definitely replied to in March, 1912.

Between the publication of the first and second reports of the Development Commission, the Board of Agriculture and Fisheries submitted their proposals for the development of the fisheries of England and Wales. The details of this scheme are not available for public inspection, but so far as can be gathered from an inspired paragraph in the *Times* the Board applied for a loan of £50,000 for the purpose of providing vessels to patrol inland waters which are not at present properly protected. A grant of £8,000 per annum was also asked for for the upkeep of these vessels, funds were also required for what was euphemistically called " a Special Commission to inquire into the grievances of the inshore fishermen." A very slight acquaintance with the terms of the Development Act would convince one that such a fatuous scheme was bound to be rejected, since the Development Fund is not available for facilitating the performance of their statutory duties by public authorities, neither can it be utilised to increase the salaries of persons in the fishery department at the Board. In forwarding their scheme to the Development Commissioners, the Board stated that the local applications were entirely covered by it, but the Commissioners were fortunately in possession of sufficient information to enable them to reply to the Board that the Board's application in no sense

[1] The Assistant Secretary for Fisheries at the Board of Agriculture and Fisheries admitted this, " As far as regards the scheme put forward by Lancashire, I may say it has been of the greatest possible assistance to the Board in the formulation of their scheme, and that as regards research work it is those proposals perhaps more than any others which have influenced the Board in the application which they have made to the Development Commissioners." *Report of Annual Meeting of Representatives of Sea Fishery Authorities* for 1911. Cd. 5870, p. 20.

covered the applications of the local authorities The second report of the Development Commissioners (September, 1912) contains some guarded reference to these matters They say that they considered the Board's application, but as they understood that a number of applications relating to fishery matters had been addressed to the Treasury by scientific bodies, local fishery committees and other authorities the Commissioners thought it desirable to obtain these before proceeding with the consideration of the Board's scheme Not being able to approve the Board's scheme, they suggested that its application should take the form of a comprehensive scheme, prepared in consultation with the Scottish and Irish authorities, for the acquisition of further knowledge of the fisheries of the United Kingdom Interim grants were recommended to a number of local bodies, but of the £78,000 asked for by the Board only £4,100 was granted

Shortly after this (January, 1913) the third Committee of inquiry, referred to above, was appointed by Mr Runciman, while they were considering the situation, the Development Commissioners issued their third report (August, 1913)

The Board's application, which had now been under consideration, was very different to their original scheme The "special commission to inquire into the grievances of the inshore fishermen" is now dropped, as is the policing scheme, and application is made for the provision of three research steamers, estimated to cost £10,000 each, annual grants of £10,000 for maintenance and £6 500 for the collection and study of material The Development Commissioners agreed in principle to this scheme, but thought it best to defer a grant for the construction or acquisition of the vessels until the scheme for which they are primarily required has been settled by consultation among the fishery authorities of the United Kingdom The advances to the local authorities were in the meanwhile continued, the dole to the Board being increased to £6 300

The fourth report of the Development Commissioners (August, 1914) announces the receipt at last of the "comprehensive scheme," but as it was received too late to come into operation in 1914-5, the Commissioners continued their grants to the local bodies in England and Wales, increasing the grant to the Board still further, to £8,600

The combined scheme provided for an expenditure in the case of England and Wales of £60 000 and £25 800 annually, of which £6 000 annually was to be devoted to grants to local institutions for local investigation and specialised research, e g experimental work on and in connection with trade products Scotland asked for £24,050 and £11,850 annually, Ireland £23,410 and £10,810 annually !

The scheme must have been in preparation at the time Mr. Runciman's Committee were considering their report, which was published in January, 1914, since it was received by the Develop ment Commissioners in December, 1913.

The contributions of the Scottish and Irish Departments to the general scheme are, as might have been anticipated from bodies which have done such excellent scientific work in the past, of practical utility and, considering the importance of the issues involved, of modest expenditure. The position in England and Wales is complicated by the fact that there local statutory bodies exist, some of whom have for years carried out fairly extensive schemes of scientific investigation. These bodies, moreover, were the first to recognise the bearing of the Development Act on the future of scientific fishery investigation, and to apply for financial assistance. When the Board's first scheme was submitted to the Development Commissioners, all these local bodies were ignored, in spite of the fact that several of them had been successfully undertaking fishery research for years. Although the Board endeavoured to assure them that their schemes, or the essential portions, at any rate, were incorporated in the Board's scheme, the Commissioners pointed out that the Board's scheme " in no sense covered " the local applications.

The revised scheme of the Board of Agriculture and Fisheries contemplates the expenditure of £60,000 the first year, and over £25,000 per annum afterwards. Of this only £6,000 a year is to be devoted to all the local authorities in England and Wales, the remainder being absorbed by the Board. The local authorities who have not been in any way consulted in the preparation of this revised scheme, and who were deceived by the Board on the first occasion, are naturally anxious for the future of scientific investigations, which have in at least one instance been carried on continuously for over twenty years. In addition to the £26,000 a year the Board expect under this scheme, there is the expenditure on England's share of the international investigations which amounts for the financial year 1914–5 to £7,530. The only hope of the local authorities is in the fairness and impartiality of the Development Commissioners, who fortunately are not at all likely to act in a hasty or injudicious manner.

It is obvious from this brief summary of the pre-war conditions that the proposals outlined in the Introductory Chapter (p. xxiii) for the establishment of a Central Fishery Council are an urgent necessity, if in the future scientific research is to be properly carried out in relation to the British Sea Fisheries.

CHAPTER XIII

FOREIGN AND COLONIAL FISHERY ADMINISTRATION

THE UNITED STATES OF AMERICA

ONE of the oldest government organisations for the development of the fisheries is that of the United States of America In 1871 their Fish Commission[1] was established with the object " of prosecuting investigations on the subject of the diminution of valuable fishes, with a view of ascertaining whether any and what diminution in the number of the food-fishes of the coast and the lakes of the United States has taken place, and if so to what causes the same is due, and also whether any and what protective, prohibitory, or precautionary measures should be adopted in the premises and to report upon the same to Congress " It was provided that the Commissioner should be a civil officer of the Government of recognised scientific attainments, possessed of practical acquaintance with the fishes of the coast The first person appointed to the post of Commissioner was Spencer Fullerton Baird, at the time Assistant Secretary of the Smithsonian Institution, and he continued to occupy the post until his death in 1887 The ability he displayed in the organisation of the Commission is undoubted, much of the efficiency of the department is due to its successful initiation, and to the fact that its work has been carried on systematically and uninterruptedly since its establishment From the very commencement the fishery service has had the active support and co operation of many of the leading biologists, fish culturists and fishery experts of the country, whose volunteer assistance has been an important factor in its development and efficiency

The work of the Commission (or Bureau, its present title) falls into three main groups Exploratory, Statistical and Fish Culture The exploratory work included a detailed investigation of the marine and fresh water fisheries of the United States, more recently

[1] *Reference should be made to* ' The United States Bureau of Fisheries Its Establishment Functions Organisation Resources Operations and Achievements by Hugh M Smith Deputy Commissioner of Fisheries *Bulletin U S F B* 1908, Part II p 1367 Washington 1910

of foreign countries, and the collection of zoological and botanical specimens for faunistic and museum purposes. The statistical work is naturally concerned with the collection of commercial fishery statistics, special attention being paid to the destruction caused by various methods of fishing, with the view of ascertaining whether overfishing existed. The third branch—that of Fish Culture—though not originally contemplated by Congress when the Commission was appointed, has developed to a very considerable extent. The introduction and propagation of fresh and salt water fish is the main object of this third section of the Bureau's efforts.

No efforts have been spared by the United States authorities to make their Bureau of Fisheries what it is to-day undoubtedly, the finest in the world. European efforts, though there has been some improvement in recent years, still pale into significance when compared with the magnificent equipment provided for the United States experts in the shape of laboratories, hatcheries and research vessels. The early years of the Bureau were devoted to an active investigation of the condition of the fisheries of the Atlantic coast, Great Lakes and other sections; to studies of the interior and coastal waters, their inhabitants, and to exploration of the offshore fishing grounds. The cultivation of useful fishes was soon taken up throughout the country, and quickly assumed large proportions.

The natural expansion of the Commission's activities was assisted materially from time to time by acts of Congress, after a few years the work had a very wide scope. Of recent years there is hardly a phase of aquiculture, of the fishing industry, or of biological and physical science as applied to the study of the waters, that does not come under the survey of the Fisheries Bureau. Originally the Commission was without any executive control in administrative matters. According to the United States Constitution, each State legislates for itself in fishery matters, and the Federal Government has assumed no responsibility. The Bureau thus had no direct voice in the framing or enforcing of measures for the protection or preservation of aquatic animals; its position in this respect, as compared with the fishery service in other countries, was anomalous.

In its advisory capacity the Bureau has acquired, however, an influence on fishery legislation; it has now been given executive powers in Alaska for the enforcement of a comprehensive code of laws for the protection of the salmon fisheries. The high standard of excellence attained by the reports of the Bureau have led naturally, even in foreign countries like Great Britain, to a careful consideration of the various opinions on fishery legislation put forward in all cases where such opinions either deal with aquatic animals of similar habits, such as lobsters and salmon, or with

similar natural conditions Since 1893 the Bureau has studied the life history and migrations of the fur seals, has inspected the conditions on the islands, and has submitted recommendations concerning the killing of the animals

Up to 1903 the Bureau was known as the "United States Commission of Fish and Fisheries," and was an independent institution of the Government, directly responsible to Congress In that year it was included in the new department of Commerce and Labour, with its present title the "United States Bureau of Fisheries' The deputy commissioner is the chief executive officer next to the Commissioner, the permanent staff of the Bureau consisted in 1908 of 325 persons, of whom 83 were on duty in Washington and 242 at outside stations, laboratories and on vessels The Commissioner's office represents the administrative division of the Bureau, having a chief clerk at its head, and under it come the accounting office, the office of the architect and engineer, the office of vessels, in addition to library, record correspondence and property office Each of the three divisions of Fish Culture, Scientific Inquiry and Statistics and Methods of Fisheries is controlled by a chief

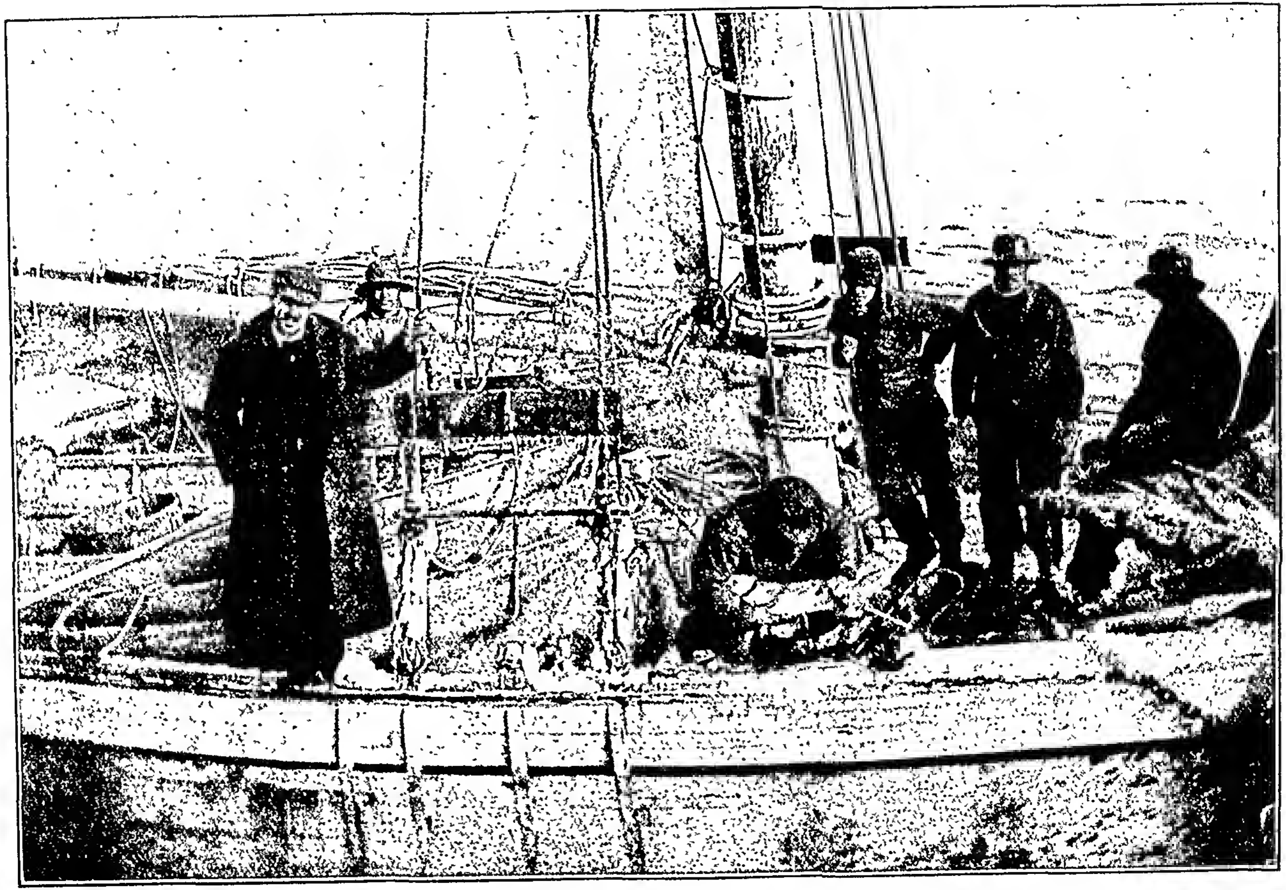
The only funds available for the support of the Bureau are those voted annually by Congress The amount so voted for the fiscal year 1917 was 1,144 850 dollars [1] The aggregate investment of the Federal Government in land at its fish hatcheries and laboratories in buildings steam and sailing vessels is estimated to be (1909) over 1½ million dollars

The artificial propagation of food fish was sanctioned by Congress in 1872, the fish to which attention was first given were the shad (*Alosa sapidissima*) the Atlantic salmon and the white fish (*Coregonus clupeiformis* a Salmonoid) This work proved so popular that it was extended annually, was supplemented by efforts in acclimatisation, and soon overshadowed all other branches

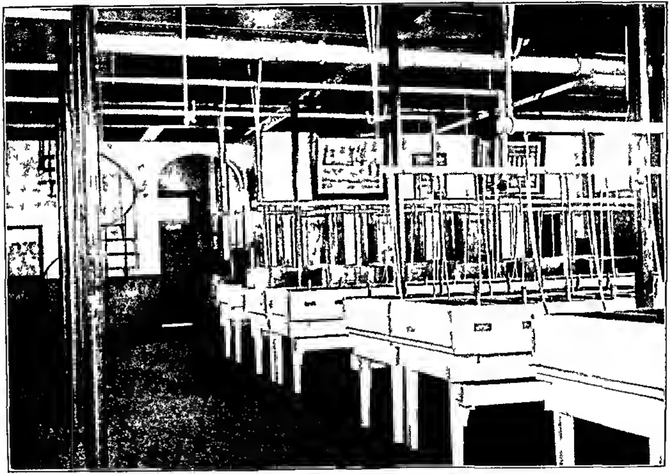
Fish culture by the United States Bureau of Fisheries is not confined to sea fish, but includes anadromous and purely fresh water forms In fact, tho whole of the organisation of the Bureau is concerned to some extent with the fresh water fisheries, some branches naturally to a much larger extent than others, and since it is impossible adequately to present the work of the Bureau by referring solely to its marine investigations, it must be understood that a certain amount of space is here devoted to subjects not ordinarily treated of in a work devoted to the sea fisheries

The policy of the Bureau as regards fish culture has been to

[1] Annual Report of the Commissioner of Fisheries to the Secretary of Commerce for the fiscal year ended 30th June 1917 Washington Government Printing Office 1917



TAKING SPAWN FROM A COD ON A GLOUCESTER (U.S.A.) FISHING SCHOONER.



BOO HBAY HARBOUR IATC IERY (U S A)
Show ng a a gemen for Inc ba on of Pe ag F sh Eggs

carry out the idea that it is better to expend a small amount of public money in making fish so abundant that they can be caught without restriction, thus serving as cheap food for the people at large, than to expend a much larger sum in preventing the people from catching the few fish that remain after generations of improvidence. Dr. Smith is of opinion that from this standpoint it is perhaps fortunate that up to the present the Bureau has not had to devote its major energies to the formulation and enforcement of fishery legislation, but has been able to work directly for the increase of fish life. The neglect of some of the states to provide the minimum protection to certain species inhabiting interstate and international waters has not only negatived the fish-cultural work of the Bureau and of the States themselves, but has practically inhibited it by preventing the possibility of securing an adequate supply of eggs, thus making desirable and necessary the institution of a new policy, placing interstate and international waters under the jurisdiction of the Central Government.

Dr. Smith says that in the work of the Bureau of Fisheries the United States Government has an especial and unique claim to the term "Paternal." From year to year, as the importance of the work has become increasingly evident, additional hatcheries have been built, the capacity of existing hatcheries enlarged, the scale of the operations extended, new species of fish added to the output, and new sections brought under the direct influence of the work. At the end of the first decade of the Bureau's existence the fish that were being regularly cultivated were shad, carp (*Cyprinus carpio*), chinook salmon (*Oncorhynchus tschawytscha*), Atlantic salmon (*Salmo salar*), landlocked salmon (*Salmo sebago*), rainbow trout (*S. irideus*), brook trout (*Salvelinus fontinalis*), and white-fish. In addition, the propagation of several other species had been undertaken experimentally. At the present time the main energies are devoted to important commercial fish, such as the shad, white-fish, lake trout (*Cristivomer namaycush*), Pacific salmons (various species of *Onchorhynchus*), white perch (*Morone americana*), yellow perch (*Perca flavescens*), cod (*Gadus callarias*), flat-fish (*Pseudopleuronectes americanus*), and the lobster (*Homarus americanus*), which are hatched by the million annually. A still more popular branch of the Bureau's activities is the distribution of those fish of the interior waters which are generally classed as game fishes. The fish hatcheries are established by special act of Congress; their location and construction are determined by the Bureau after a careful survey of the available sites in a given state. While marine operations have been conducted from time to time at various places on the Atlantic coast from Maine to Florida, and addressed to a

large number of species, the only permanent marine hatcheries are in Maine and Massachusetts

In 1913[1] more than 95 per cent of the output of the fish hatcheries consisted of important commercial species, notably the salmonidæ, shad, white-fish, pike perch (*Stizostedion vitreum*), yellow perch, white perch, lake trout, cod, pollock (*Pollachius virens*), haddock, flat fish and lobsters Of these the marine species are principally planted on the inshore fishing grounds of the Atlantic

The first consideration in the Bureau's distribution of fishes is to make ample return to the waters from which eggs or fish have been collected The remainder of the yield of the hatcheries is consigned to suitable public or private waters upon application, endorsed by a United States Senator or Representative, the Bureau furnishing to persons interested an application form for this purpose

The fish are carried to their destination in railroad cars equipped for the purpose, or by messengers who accompany the shipments in baggage cars, and are delivered to the applicant free of charge, at the railroad station nearest to the point of deposit The applicant is advised by telegraph when the shipment will arrive, and is expected to make due provision of the fish till planted Definite instructions in this respect are furnished at the time of shipment

Fish are distributed at various stages of development, according to the species, the number in the hatcheries and the facilities for rearing The commercial fish—such as the shad, white fish, lake trout pike perch and cod—hatched in lots of many millions, are planted as fry soon after hatching Atlantic salmon, landlocked salmon and various species of trout are reared in such numbers as the hatchery facilities permit, to fingerlings from 1 to 6 in in length, the remainder being distributed as fry

The report for the fiscal year ending the 30th June, 1918, including regular, deficiency and special appropriations aggregated \$1 263 560, that is over £250 000

The chief items of expenditure are Salaries £88 112, propagation of food fishes, £75 000, maintenance of vessels, £18 000, inquiry respecting food fishes, £10,000, protecting salmon and seal fisheries of Alaska £22 000, repairs to steamer *Fish Hawk*, £7 000, rebuilding laboratory at Fairport, Iowa, £16 000, improvements and purchase of land at fish-cultural stations, £3 300, improvements at fish cultural stations, £3 600 In addition there were certain special allotments not included in the above, for national security

[1] The Distribution of Fish and Fish Eggs during the Fiscal Year 1913 by Robert S Johnson Department of Commerce Bureau of Fisheries Document No 794 Washington *Government Printing Office 1914*

and defence. Some of these, though in their origin war-time measures, seem likely to develop into features of permanent value.

The first allotment, for £6,000, was to secure an immediate increase in the production of aquatic foods on all parts of the United States coast, the second, for £4000, was to enable the Bureau to co-operate with the food administration and the State fishery authorities in increasing the production of food fish in the Gulf states.

An allotment of £5000 was also made for an installation of a plant at the Pribiloff Islands to utilise seal carcasses in producing a commercial grade of oil and fertiliser. Finally £25,000 was allotted for the erection and maintenance of a fisheries-product laboratory in Washington, the capital city. The primary purpose of this laboratory is to induce increased production and consumption of aquatic foods through the dissemination of improved methods of preservation. The total output of fish and fish eggs in the United States for the year ending 30th June, 1918, was over 4,098 million. The principal marine species dealt with were the winter flounder or American flat-fish, 2,455 million; pollock, 233 million; cod, 77 million; lobster, 66 million; and haddock, 17 million, all fry. The sea basses (*Serranidæ*) are represented by the white perch with nearly 3 million fry, and the striped bass with over 14 million fry. The fish cultural work for the fiscal year 1918 showed a decrease of approximately 20 per cent compared with 1917. This was chiefly attributable to adverse weather conditions during the spawning time of various commercial species, such as the cod, pollock and pike-perch, whose eggs are handled in large numbers.

The exploratory or scientific inquiry branch of the Bureau's activities has also gained considerable reputation, not only at home, but in foreign countries as well. In making the original plans for the systematic investigation of the waters of the United States and the biological and physical problems they present, Commissioner Baird insisted that to study only the food fishes would be of little importance, and that reliable conclusions must rest on a broad foundation of investigations purely scientific in character. The life history of species of economic value should be understood from beginning to end, but no less requisite is it to know the histories of the animals and plants upon which they feed, or upon which their food is nourished; the histories of their enemies and friends, as well as the currents, temperatures and other physical phenomena of the waters in relation to migration, reproduction and growth. In pursuance of this policy the Bureau has secured the services of many prominent men of science, and much of the progress in the artificial propagation of fishes, in the investigation of fishery problems, and in the extension of knowledge of the aquatic resources

of the United States has been due to men eminent as zoologists, who have been associated temporarily with the work of the Bureau Their services have been the services of specialists for particular problems, and through them the Bureau has not only been able to give to the public the practical results of applied science, but has contributed to pure science valuable knowledge of all forms of aquatic life The small permanent staff of the Bureau concerns itself more directly with studies of fish and their environment, with the preservation of diminishing commercial species and the development of new or improved methods of increasing the supply

Such lines of work are undertaken as necessity arises or as assistance is asked for The most important work of recent years has been concerned with aquatic products other than fish, namely oysters, fresh-water mussels, sponges and the diamond back terrapin (a species of tortoise), in all of which cases the problem is to find means to counterbalance the results of long-continued overdraft upon natural supply The Bureau also employs a fish pathologist, a position specially created by Congress at the request of the Commissioner Much time has been given to the study of diseases among fish at the hatcheries of the Government and the various states, which has resulted in a great extension of our knowledge of the causes and prevention of many of the affections which attack fish under cultivation The work of the pathologist also includes the investigation of conditions due to pollution of waters

Two marine laboratories are maintained by the Bureau One is at Woods Hole, Mass, where it was built in 1883 in conjunction with a marine fish hatchery The other laboratory is situated on a small island near Beaufort, N C, and was built in 1901 In each case the land was given by private individuals In addition to their work on behalf of the Bureau itself these laboratories are available to the public for the purposes of study and scientific research University students, professors and other qualified investigators may have the facilities of the laboratories on request, and these facilities are largely used every year

For the survey of the offshore fishing grounds, the study of pelagic fish and the general exploration of the sea, the Bureau has had, since 1882, the steamer *Albatross*, which was specially designed and built for the work, there is no doubt that this vessel has contributed more to the knowledge of the life and physics of the sea than any other

The *Albatross* is a twin-screw steamer, rigged as a brigantine of 1,074 tons displacement, 384 net tonnage, built at a cost of $190,000 The complement of officers and men is furnished by the navy, and there is, in addition, a small civilian staff, including a resident

naturalist and fishery expert. After spending several years in the investigation of the fishing grounds of the Atlantic coast of North America the *Albatross* was sent to the Pacific Ocean in 1888, and has since confined her operations to those waters. She has made three extended cruises to the southern and eastern parts of the Pacific, several cruises to the Hawaiian Islands and Japan, and many visits to Alaska, in addition to numerous surveys on the coast of the Pacific states, all having for their object the investigation of the physics and biology of the regions visited, the determination of their aquatic resources, and the study of their fisheries. In 1907 the vessel commenced a biological survey of the waters of the Philippine Archipelago, and was engaged on that work until 1910.

Work similar to that done by the *Albatross* is carried on by the steamer *Fish Hawk* on the Atlantic coast. This vessel, built for the Bureau in 1879–80, is of 441 tons gross burden, and has a naval crew of forty-five. She is equipped for sounding and dredging, and has recently been employed, while attached to the laboratory at Woods Hole, in the exploration of the coastal waters and inshore fishing grounds of New England. The *Fish Hawk* is convertible into a hatchery, and has been engaged in the hatching of shad and other fish along the entire coast from Maine to Texas.

The first task of the Bureau of Fisheries, namely the investigation of the reported decrease of food fish in New England, necessarily involved the collection of statistics of production, personnel and capital. This branch of the work has been conducted from the commencement without interruption; in it have been included various other subjects affecting the economic and commercial aspects of the fisheries. Among its functions are (1) a general survey of the commercial fisheries of the country; (2) a study of the fishing grounds with reference to their extent, resources, yield and condition; (3) a study of the vessels and boats employed in the fisheries, with special reference to their improvement; (4) a determination of the utility and effect of the apparatus of capture employed in each fishery; (5) a study of the methods of fishing, for the special purpose of suggesting improvements or of discovering the use of unprofitable or unnecessarily destructive methods; (6) an inquiry into the methods of utilising fishery products, the means and methods of transportation, and the extent and condition of the wholesale trade; (7) a census of the fishing population, their economic and hygienic condition, nativity and citizenship; (8) a study of international questions affecting the fisheries; (9) the prosecution of inquiries regarding the fishing apparatus and methods of foreign countries.

The collection of statistics of the commercial fisheries and the

industries dependent on them constitutes the major portion of the work

During the calendar year 1911, the fisheries of the United States, including Alaska, but excluding insular possessions, may be regarded as having had the following approximate extent Persons engaged, 225,000; vessels employed, 7,500 of 217,000 tons; total capital invested, $65,600,000, yield, $76,000,000, this sum representing the first value of the various products. At present the fisheries of the United States are more valuable than those of any other country. The two most important fishing ports on the Atlantic coast are Boston and Gloucester. During the calendar year 1911 vessels from these two ports made 6,800 trips to the fishing grounds, landing 185,153,367 pounds of fish, valued at $5,024,497.

The cod is the most valuable product of these fisheries, but the haddock, ranking second in value, is taken in somewhat larger quantities Next in rank among the ground fish are the hake, halibut, pollock and cusk Of the surface-swimming fish mackerel and herring are the most important.

The history of the Alaskan salmon inspection service is one full of interest, for the details reference should be made to the various official reports issued by the Bureau

From the beginning of its career the Bureau of Fisheries of the United States has maintained cordial relations with the fishery authorities of the various States In addition the relations of the Bureau with similar departments in foreign countries has always been of the best possible description There appears to be no limit to the courtesy of the United States fishery officials, certainly no effort is spared to assist inquirers from foreign countries No one acquainted with Dr Hugh M Smith, the present Commissioner of Fisheries, can fail to have been impressed with this most gratifying feature of the Bureau's activities

The Bureau has made many gifts of American fish eggs to foreign Governments, the hardiness of these eggs and the facility with which they can be transported out of water for long distances, have resulted in the establishment of some of the best food and game fish in distant lands The brook trout and other American salmonoids are now thriving in Argentina, the brook trout, the rainbow trout, and the black bass are widely distributed in Europe; the rainbow and brook trouts are found in several Japanese lakes; and some of the finest trout fishing in the world is afforded by the rainbow trout in New Zealand, where also the chinook salmon, the blue-back salmon, and various other American fish are now flourishing.

The volumes which represent the United States Bureau of

Fisheries in official publications constitute without a doubt the finest collection of authoritative papers on fishery problems in the world. To give a few instances only; the best account of the beam-trawl fishery of Great Britain (at the time it was written) of the Marine Biological Stations of Europe, of carp culture, of general fish-hatching and rearing, are to be found in these volumes, the general subject matter of which is co-extensive with the scope of the operations of the Bureau—it is biological, fish-cultural and commercial, treated from standpoints both technical and economic.

The Manual of Fish-culture, first issued in 1897 and revised in 1900, is unquestionably the standard work on the subject. The seven volumes devoted to the Fisheries and Fishing Industries of the United States, by Commissioner Goode and his colleagues—Clark, Collins, Earll, Elliott, McDonald and True—though published nearly thirty years ago, still remains a standard work of reference.[1] Of special interest and value to students of the sea fisheries are the numerous publications by Evermann, either alone or in collaboration, on the fishes of the Hawaiian Islands, of Porto Rico, of the interior and coastal waters of America; the reports of Benedict, Rathbun and others on crustacean resources; the papers of Herrick on the American lobster; of Kunz on pearls; of Moore on oysters and oyster culture; of Parker and Herrick on the special senses in fish; and numerous other papers.[2] In addition to the above the publications treat of the physical conditions in lakes and streams, the methods used in deep-sea investigation, and all forms of minute animal and plant life in their relation to fish extending into the fields of oceanography, hydrography, geology and chemistry as well as biology. The Bureau is thus responsible for a literature which no bibliography devoted to the sea fisheries could possibly omit, having an educational value of the highest degree.

For the first ten years of the Bureau's existence its publications were comprised in a series of annual octavo volumes, known as the Commissioner's Report. In 1881 another series was begun, likewise an annual publication, and called *Bulletin of the United States Fish Commission*. The two series lasted until 1905, when new legislation brought about a change. The bulletin remains as before, an annual report. The Commissioner's Report is no longer a bound volume containing a detailed account of the year's work, with special reports appended, but is reduced to a brief administrative statement of

[1] See also, *A History of the New England Fisheries*, by R. McFarland, University of Pennsylvania. Series in Political Economy and Public Law. New York, 1911.

[2] Students of marine faunæ of interest from a fishery standpoint, should also refer to the publications of the Smithsonian Institution, e.g. Goode and Bean's *Oceanic Ichthyology*, True's *Whalebone Whales of the North Atlantic*, and others.

results The special reports formerly published as appendices are now issued as separate independent pamphlets with distinct title pages and covers, not at distinct intervals, but from time to time when and as available In conclusion one may add that this is a record to fill one with envy and despair

FOREIGN FISHERIES—EUROPEAN

Austria

The sea fisheries were under the Imperial Marine Authority at Trieste, which was in turn responsible to the Ministry of Commerce and Agriculture [1]

Belgium

The Belgian fisheries were the concern of the Ministry of Industry and Labour The official fishery statistics are published in the annual *Tableau General du Commerce avec les Pays etrangers* For a comprehensive account of the sea fisheries of Belgium reference should be made to Charles de Zutteres *Enquête sur la pêche maritime en Belgique,* premier partie Étude économique de la pêche maritime Bruxelles, 1909

Denmark

The fishing industry in Denmark is administered by the Department of Agriculture, except as regards the Faroe Islands, where the fishery is controlled by the Ministry of Justice The chief official is the General Fishery Inspector, who is also adviser to the Department in all questions affecting the sea fisheries There is a separate inspector and adviser for fresh water fisheries The duties of the fishery administration are to supervise the enforcement of the Danish Fishery Law, the Regulations and By laws made thereunder, of regulations made under the Swede Danish Convention respecting the seas bordering Denmark and Sweden The administration also supervises fishery research supported by the State, the operations of loan societies for fishing boats, and the inspection of fishing vessels provided with the help of direct loans from the State The collection of statistics, experiments in fish hatcheries and fish propagation are also undertaken

[1] For statistics the *Statistische Monatschrift* and the *Statistisches Jahrbuch* for Austria should be consulted There are also two papers by Anton Krisch Die Seefischerei Statistik der im Reichsrate vertretenen Länder (*Volkswirtschaftliche Wochenschrift Wien* 23 und 30 Mai 1889) and Die Osterreichische Seefischerei (*Schriften des Vereins für Socialpolitik* CIV, 2)

The officials are required to do all in their power to promote the fisheries and to advise and assist fishermen in their calling. There is a State Biological Station under the Department of Agriculture. The amount of money provided by the Government for scientific fishery investigations in Denmark is about £6,525 per annum, of which £4,387 are devoted to the international researches. In 1912 there were 17,183 fishermen and 14,162 fishing boats in Denmark, excluding 601 vessels and 638 fishermen engaged in the Ringkobing and Nissum Fjords.

In Denmark the fishing industry is largely an inshore one, and the total value in 1912 was estimated at £908,597, excluding Ringkobing and Nissum Fjords, valued at £17,354.[1]

Under the stimulus of the German demand the Danish fisheries increased enormously after the outbreak of war.

The following tables gives an idea of the increased earnings of the Danish fishermen.

VALUE OF FISH LANDED IN DENMARK

1914	£960,730
1915	£1,473,610
1916	£3,210,700

As a rule it is the plaice fisheries which are the most important, but in 1916 the haddock came first, herring next, then cod, eel and plaice. Of haddock 24,304 tons, value £838,280 were landed in Denmark and exported, for the most part, to Germany.

In 1916 Denmark exported 1,668 tons of fish to England compared with 5,883 tons in 1915. Nearly all the fish arrived between January and May, only 247 tons arriving after the latter month. Probably between 50,000 and 60,000 tons of fish went from Denmark to Germany in 1916. The demand was keen and prices high.

FRANCE

There is a central fisheries office at the Ministry of Marine, Statistics referring to France and Algeria are published annually in the *Statistique des Pêches Maritimes*. Details of the French fisheries at Iceland and Newfoundland may be found in the *Revue Maritime, Paris* (for 1910 see Vol. CLXXXVII).

The French Colonial fisheries are dealt with in *L'industrie des Pêches aux Colonies*, par Darboux, Cotte, Stephan et Van Gaver. Marseille. Barlatier, 1906.

[1] For further details refer to *Dansk-Fiskeritidende*, Helsingör (a weekly journal published by the Dansk Fiskeriforening (Danish Fishery Society); also a yearly Report of the same Society, *Aarsberetning for Driftsaaret*. The *Fiskeribladet* is the journal of the Danish Fish Traders' Association (Dansk Fiskehandler og Havfiskeriforening).

Broadly speaking, the fisheries of France are divided for statistical and administrative purposes into the "Grande Pêche" and the "Petite Pêche" The former term is applied to the cod and whale fisheries almost exclusively The cod fisheries carried on by French fishermen on the Banks of Newfoundland are well known, and an account of these by Duhamel has already been referred to (p 12) The "Petite Pêche" corresponds to some extent to the term coastal fishery as applied to British Fisheries An historical account of the legislation affecting the coastal fisheries of France has been given by Pizzetta [1] The effect of these regulations and particularly of the decree of the 10th May, 1862, so far as they relate to the prohibition of capture and sale of undersized fish is given in a British Government Blue Book entitled "Sea Fisheries (Restrictive Legislation in Foreign Countries)"[2]

Germany

There was no branch of the Imperial Government in Germany charged with fishery administration A fishery society, the Deutscher See Fischerei-Verein, was used by the Central Government for the general development of the sea fisheries The Reichstag voted the Society between 1886 and 1910, both years inclusive, the sum of £362,500 for the development of the sea fisheries, the average per annum being £13 700 The vote for 1913 was £25 000 Since German fishermen were compelled to serve in the Navy, it follows that the development of the sea fisheries was a close concern of the naval authorities [3] Fishery charts were prepared by the naval authorities for the use of the fishermen, in many other ways the naval authorities fostered the growth of the sea fisheries [4] In 1885, the year before the See Fischerei-Verein was founded, Germany possessed only one fishery steamer In addition there were "numerous" sailing boats of small size in the Baltic, and a few hundred sailing boats in the North Sea

In 1907 Germany possessed 924 registered fishing boats, of which 284 were steamers, the crews amounted to 7,182 men In addition there were 14 726 unregistered vessels of smaller size, manned by 22,269 fishermen

Greece

In spite of its sea coast, Greece is a fish-importing country. There is a considerable import of dried fish from Norway and New-

[1] *La Pisciculture fluviale et maritime en France* p 358 Paris 1880

[2] No 271 London 1901 p 153

[3] Die Weiterbildung der Hochseefischer während ihrer Dienstzeit an Bord der Fischereischutzfahrzeuge von v Holleuffer *Mitteilungen des Deutschen Seefischerei Vereins* Bd 29 1913

[4] *Abhandlungen des Deutschen Seefischerei Vereins* Bd II Berlin 1910

foundland, chiefly through the Piræus and Patras. Information on Greek fisheries is given in *Piscifacture Marine et les Poissons de la Lagune de Missolonghi,* par P. Panagiotopoulos. Ministere de l'economie nationale. Athènes, 1916.

Holland

The Minister of Agriculture, Industry and Commerce is responsible for fishery administration; the chief officials being the Scientific Adviser and the General Inspector of Fisheries. There is also a Board of Fisheries of not more than twenty-one members nominated by the Crown. The members of the Board are not in receipt of a salary, but travelling and subsistence allowances are granted to enable them to attend the Board meetings. There is a salaried secretary and four committees, for sea fishery; for coast fishery; for inland fishery; and for legal and economic questions. The Board has the right to ask the Scientific Adviser in Fishery matters and the Chief Inspector of Fisheries to attend the meetings for advice; but neither of these officials has a vote. There are also certain special councils composed of practical fishermen, but these are mainly concerned with the inland fisheries. Much of the research work is carried on at the Marine Station of the Zoological Society of the Netherlands, the results of these researches are generally published as appendices to the Annual Reports of the Board of Fisheries.[1] A special scientific bureau has been established in connection with the international investigations in the North Sea. The vote for scientific investigations amounted in 1912 to £4,153. In 1911 there were 11,819 Dutch fishermen engaged in the sea fisheries, with a fleet of 149 steam, 12 motor and 1,124 sailing vessels. At the North Sea ports of the Netherlands, there was landed 2,311,331 cwt. of sea fish of the value of £1,378,597.[2]

The outbreak of the great war brought immense profits at first to the fisheries of the neutral nations. There was an enormous demand for fish from Germany, and in 1915 and 1916 Holland poured supplies into Germany. In 1917 there was a remarkable change. Owing to the destruction of numerous trawlers and luggers by German submarines and mines, and the closing of great tracts of the North Sea by the German and British barred zones, fishing was confined to the home waters. The quantity of sea fish landed in Holland in 1916 amounted to 165,513 tons of the value of £6,637,226, but in 1917 this declined to 33,579 tons, value £1,374,810.

[1] Verslag van den Staat der Nederlandsche Zeevisscherijen.

[2] See also a monthly journal, *Mededeelingen over Visscherij*, and for other scientific papers, see "Jaarboek van het Rijksinstituut voor het onderzoek der Zee," and "Verhandelingen uit het Ryksinstituut voor het onderzoek der Zee."

In 1916 the steam trawlers made 3 919 voyages, aggregating 30 231 fishing days, but in 1917 only 248 voyages and 8,293 fishing days

In 1916 the steam trawler landings were 56,180 tons, value £2,380,958, in 1917 only 14,377 tons, value £672,319 For several of the later months of 1917 no Dutch steam trawler put to sea In the drift net fishery only three voyages were made by steam luggers, compared with 286 in 1916, their catch was 20 tons, value £1,000, compared with 11,696 tons, value £421,730 in the previous year

In 1917 the British Government endeavoured to prevent the export of fish from Holland to Germany, or at least to confine it within very narrow limits A number of Dutch herring boats were seized in the North Sea, brought into Aberdeen, Kirkwall and other East Coast ports and there detained This led eventually to an agreement between the Dutch owners and the British Government, which may be summarised as follows Germany was not to receive more than 20 per cent of the Dutch catch, 20 per cent was reserved for home consumption and the remaining 60 per cent was to be sold to neutrals The British Government was to pay a bonus of 30s to the Dutch fishing vessel owners for every case of fish (115 kilos or 253 lb) sold to neutrals

ITALY

The sea fisheries of Italy are administered by the Ministry of Marine, except the deep sea fisheries, which come under the Finance Minister In 1910 there were 115 577 Italian fishermen engaged in the sea fisheries The deep sea fishermen are for the most part Venetians, the coastal fishermen Sicilians Sea fishermen comprise roughly about one-third of the Italian seafaring population The produce of the sea fisheries was estimated at (in 1910) £960,468 There were 27,422 fishing vessels with a tonnage of 75,872 [1]

NORWAY

Before 1900 the fisheries were administered directly by the Minister of the Interior In that year the Fisheries Department was created and made subordinate to the Department of Commerce The head of the Fisheries Office is called the Director of Fisheries. The Fishery Budget provides for an annual expenditure of about 400,000 kroner (£22,500) All questions of an administrative nature or affecting legislation touching fishing interests are sub-

[1] For further details see Annuario statistico Italiano sulle Condizione della marina mercantile Italiana al 31 Dic 19 , Relazione del Direttore Generale della marina mercantile (Roma 19) and Economic Conditions of the Fisheries in Italy by Guido Rossati *Bulletin United States Fish Bureau for 1908* p 323 Washington 1910

mitted to the Director of Fisheries for his report. Information respecting fish and fish markets at home and abroad is collected by the bureau, and disseminated by post and telegraph. A weekly paper, the *Fiskets Gang*, is published in which all particulars are collected, while consular reports and those of the fishery agents, who are maintained by the Bureau in Hull and Hamburg, are also included. The preparatory work with the sea fishing funds, created for the promotion of a modern sea fishing fleet, is carried out by the Bureau. The total capital is now (1914) £118,125.

The Government possess a research steamer the *Michael Sars*, which is used for practical fishery investigation in the waters of importance to Norwegian fishermen, as well as for scientific exploration of the deep sea. There is a fishery council, which is an advisory body of nineteen members elected by the various fishery districts of the country. It meets for a week every autumn and considers the budget prepared by the Director, and other matters of importance referred to it by the Department of Trade, the Director or by one of its members. The total value of the fisheries of Norway was, in 1912, about £3,009,531.[1]

PORTUGAL

The Central Commission of Fisheries, of the Department of Marine, undertakes the supervision of the Fisheries of Portugal. Statistics are published annually in the *Estatistica das Pescas Maritimas.* For an account of recent development of the Portuguese fisheries see Klein *Fischerei und Salzgewinnung in Portugal.* Mitteilungen des Deutschen Seefischerei-Vereins, Bd. 29, 1913, p. 212). In 1910 the number of men engaged in the sea fisheries of Portugual, including Madeira and the Azores, was 29,525. In fish preserving and other shore industries a large number of persons are engaged, in all probably not less than 70,000, that is above 1 per cent of the total population. In 1910 the number of boats was 11,533, with a tonnage of 42,431, valued at £385,558. The value of nets and gear was £866,563, the catch of fish £854,014. The Portuguese are a great fish-consuming nation, in addition to the consumption of part of their own catch, there is an import of fish to the estimated value of £750,000 annually. The bulk of this is salt cod (£625,000). Fishery products are the fourth most important export of Portugal (the others being wine, cork, fruit and vegetables) of these sardines in an average year constitute about 70 per cent.

The number of Portuguese steamers engaged in the sea fisheries

[1] For further particulars see, *Norsk Fiskeralmanak*, published annually at Bergen, by the Selskabet for de norske Fiskeriers Fremme; and in addition to *Fiskets Gang*, referred to above, see the *Annual Report of the Fishery Department* (Aarsberetninger vedkommende Norges Fiskerier).

increased from 3 in 1905 to 26 in 1910, and in the latter year the number of fishing voyages made by these steamers was 662, the catch was valued at £140,611 In 1906, 66 foreign steamers landed their catches of fish in Portugal, of these 10 were German, the number of journeys was 374 (German 64), the total value of the catch £147,993 (German £38,369) Portuguese trawlers pay no harbour dues or duties on fish landed, but in lieu thereof an annual tax of £337 Foreign trawlers pay £6 15s harbour dues per landing, and 10 reis per kilogram on the fish landed

As a result the landings by *foreign steam* trawlers shows a decline In 1910 there were 50 foreign steamers which landed fish in Portugal (of these 6 were Germans), the number of voyages were 424 (German 93), the value of fish being £108,000 (German £36,198)

Roumania

The most important of the Roumanian fisheries is that for the sturgeon of the Danube The sea fisheries are not important There is a publication (in the Roumanian language) entitled, *Fauna Ichtiologica A Ramanici*, de Dr Gregor Antipa Academia Romana Publicatiuni Fondului Vasile Adamachi Published by Carol Gobl 16 Strada Doamnii, Bucarest Prior to 1908

Russia

In Russia fishery administration was undertaken by the Imperial Ministry of Land and Agriculture Fishery Statistics are published by the Department of Agriculture annually in a volume entitled, *Recueil de Donnees Statistiques et Economiques caracterisant la situation agricole en Russie* For an account of the fisheries of Russia reference should be made to a paper by Borodine entitled " Pêche et Pisciculture en Russie " (Atti del V Congresso internazionale di Pesca, Roma, 1913)

Spain

In Spain, fishery administration is the concern of the Ministry of Marine In 1904 it was estimated that there were 121,394 persons engaged in the Spanish fisheries There were 400 factories engaged in the preparation of sardines, tunny, bonito, eels, lampreys and other fish for the market The estimated annual value of the fisheries was in 1904 about £1,828,090, the value of the vessels, nets, gear, etc, £1,797,385 [1]

[1] (*For a concise account of the Fisheries of Spain reference should be made to Monographie de la pêche maritime en Espagne* Réponse que les Délégués officiels du Ministère de la Marine d Espagne donnent au recueil des questions remis par l Ambassade d Autriche Hongrie à Madrid Stenographisches Protokoll über die Verhandlungen des internationalen Fischerei Kongresses Wien 1905 Wien Verlag der k. k œsterreichischen Fischerei Gesellschaft 1906 p 179 There is an interesting bibliography of Spanish fisheries appended to this paper on p 194)

Sweden

Central Fishery Administration in Sweden is undertaken by the Department of Agriculture, an assistant secretary being in charge of the fisheries. Apart from headquarters, the chief officials are Fiskeri-Intendants (fishery inspectors), of whom there are six, one for each fishery district. These fishery inspectors must have had a scientific training; apparently ignorance of the subject which one administers is not considered essential in Sweden. A candidate for the post of Fiskeri-Intendant must have passed for a licentiate in philosophy in the mathematical and natural science section, and have obtained certificates in botany and zoology. He must also have served for five years as Fiskeri-Assistant. The duties of the fishery inspector are thus defined in the Royal Ordinance creating the post :—

" To seek by all means to promote the development of the fisheries, and accordingly to place himself in communication with the local rural economy association and its executive committee; to bring proposals before the suitable persons in the district for taking means for improving the industry by affording its members, upon their request, information, counsel and reports; to try and promote the formation of fishery associations under the control of the Department of Agriculture; to conduct investigations in and prepare descriptions of the fishing-grounds in the district; to promote fish hatcheries and the propagation of fish in the lakes and channels, while generally preserving and improving the various species of fish; to try and check the extirpation of fish by their enemies or by pollution of the water or by other means; to contribute towards the preparation of exact fishery statistics; and upon request to furnish authorities with assistance in the way of information and advice on fishery questions."[1]

The British Empire

India

There is no central fishery administration in India. The fishery interests are a concern of the separate provinces, and the importance of the fisheries varies immensely. In Burma, Bengal and Madras there are important sea fisheries, unquestionably capable of considerable development. The provinces of Bengal, Bihar and Orissa are at present united for fishery investigation and administration; the fishery department being under the control

[1] See also a monthly journal, the *Svensk Fiskeritidskrift*, published at Stockholm, and also a fortnightly paper, the *Fiskerierna*, published at Göteborg.

of the Directors of Agriculture There are a Director of Fisheries and two Superintendents of Fisheries At present the first official is a European, the two latter being natives of India Madras has an efficient, if small fishery department At present the head of the fisheries department is directly responsible to Government

Recent information of the fisheries of Madras, Bengal Bihar and Orissa, and the former province of Eastern Bengal and Assam is contained in the reports of Nicholson,[1] Gupta,[2] Southwell[3] De[4] and others

Federated Malay States

An annual report on the fisheries is issued by the Government That for 1914 shows the revenue from fishing and fishing boat licences to have been $26 948 (about £2,700), which was the largest hitherto secured The total number of fishermen was 3 918, and the taxation per head about 7 dollars The fishermen are Chinese and Malays The report contains detailed statistics of the exports, imports and fishing licences for the three States of Perak Selangor and Negri Sembilan[5]

Australia

There are both Commonwealth and State Departments The former is under the Department of Trade and Customs, and the central office is at present in Melbourne The chief official is entitled Director of Fisheries Owing to the unfortunate loss at sea, with all hands, of the Commonwealth fishery investigation steamer, research work is at present in abeyance An attempt has been made to establish State-aided steam trawling in New South Wales but according to recent reports (1919) this has not proved a financial success

Of the various States the New South Wales fishery department is

[1] *Note on Fisheries in Japan* by Sir F A Nicholson K C I E Madras Government Press 1907 Contains suggestions for the improvement of the Fisheries of Madras on p 87 *et seq* and Government of Madras G O No. 1857 9th August 1915 Reviewing Sir F Nicholson s report on the work done in the Fisheries Department during 1914 15

[2] Reports on the results of enquiry into the fisheries of Bengal and into fishery matters in Europe and America by Sir K G Gupta K C S I Calcutta. The Bengal Secretariat Book Depot 1908

[3] Department of Fisheries Bengal Bihar and Orissa Bulletin No 5 Report on Fishery Investigations in Bengal Bihar and Orissa with recommendations for future work, by T Southwell Calcutta. The Bengal Secretariat Book Depot 1915

[4] Report on the Fisheries of Eastern Bengal and Assam by K. C De Shillong The Eastern Bengal and Assam Secretariat Printing Office 1910

[5] Federated Malay States Report of the Fisheries Department for the year 1914 For a description of the methods of fishing see *The Fishing Industry of Krian and Kuru Perak* by A T Dew Journal Straits Branch Royal Asiatic Society No 23 June 1891

the most active.[1] The fishery offices are associated with the following departments: South Australia, Department of Crown Lands, Mines and Agriculture; West Australia, Office of the Colonial Secretary; New South Wales, Department of Chief Secretary; Queensland, Marine Department of the Treasury; Tasmania, Office of the Chief Secretary; Victoria, Department of Agriculture.

New Zealand

The fisheries of New Zealand[2] are at present undeveloped. The inshore waters from 10 to 30 fathoms are not less than 30,000 sq. miles, and there are about 25,000 sq. miles between 40 and 50 fathoms. Outside these grounds the depths sink rapidly to 300 and 400 fathoms. New Zealand has large inland lakes, the area including rivers being approximately 15,000 sq. miles. About 1,500 persons are engaged in the fish trade, and of these a thousand are fishermen. The annual value of the fish caught does not exceed £100,000. The imports of fish amount to £110,000. Over 300 species of teleostean fish have been described in New Zealand, and of these about 35 are regarded as food fish.

Canada

The sea fishing grounds[3] off the Atlantic coast of Canada exceed 200,000 sq. miles, the area covered by the Pacific grounds exceeds 40,000 sq. miles, and the fresh water area is 220,000 sq. miles, 75,000 of it being the Canadian portion of the Great Lakes. Hudson's Bay has been little developed except for whaling, walrus and seal hunting, a vast area with a drainage extent of 370,000 sq. miles. Ten rivers are over 1000 miles long, the longest being the Mackenzie, 2500 miles.

The total catch has increased in value from £3,788,234 in 1892 to £7,841,675 in 1917. The total weight of fish captured is not less than 669,000 tons. The number of vessels engaged in 1892 was 988, in 1917 it was 1965, while boats and light craft had increased in the same period from 30,513 to 40,105. There are now about 12,000 motor boats engaged in the fisheries, half of them in Nova Scotia alone.

[1] D. G. Stead, *Fishes of Australia* (Sydney, 1906); *A Brief Review of the Fisheries of New South Wales* (Sydney, 1910); *The Edible Fishes of New South Wales* (Sydney, 1908); *New Fishes from New South Wales* (Sydney, 1908).

[2] See a paper by Prof. E. E. Prince in the *Fishing Gazette*, New York, for 5th August, 1916; also the *Transactions of the New Zealand Institute*, Vol. XXXVIII, 1905, for a paper on the "Portobello Marine Fish-hatchery and Biological Station," by G. M. Thomson; and *Trans. N.Z. Inst.*, Vol. XXXIX, 1906, for "Observations on New Zealand Fishes," by T. Anderton.

[3] See Annual Reports, Department of Marine and Fisheries, Canada.

Canadian waters have recently been exploited by French, British and American steam trawlers, no less than twenty-two French trawlers working off the Gulf of St Lawrence

Canadian fisheries fall into seven main divisions, viz —

(1) The Atlantic division, from the Bay of Fundy to the coast of Labrador, including both deep-sea and inshore fisheries The chief fish caught are cod, mackerel, haddock, halibut, herring, hake, lobsters, oysters, seal and white whale (Beluga)

(2) The estuarine and inland waters of the Maritime provinces (Nova Scotia, New Brunswick, Prince Edward Island and Quebec) Chief fish are salmon, shad, alewife, striped bass and smelt

(3) The great lakes and tributary waters with Lake white-fish, trout, sturgeon and pike-perch

(4) The great north west lakes, including Manitoba and northern waters

(5) The Pacific interior or Rocky mountain plateau with land-locked salmon, trout and numerous cyprinoids

(6) The Pacific coast fisheries with their famous salmon, of which at least seven different species occur

(7) Hudson Bay and circumpolar regions with whale, walrus, sea-trout, with white-fish, pike and sturgeon The richest whaling grounds in the world are in this region, off the mouth of the Mackenzie River, and as far east as Cape Chudleigh, in Hudson Strait

Newfoundland (Including Labrador)

The total value of all exports from Newfoundland was in 1914 about 15 million dollars, of which the fishery products account for nearly 11 million dollars Of this amount cod-fish represents a little over 8 millions, the various oils nearly a million These are cod, whale and seal oil Other exports are sealskins and tinned lobster The chief fishery is for cod, the exports of cod for 1914 were 1,247,314 quintals (cwt), value $8,071,889

The chief markets for cod are in the Mediterranean In 1913 Greece took 60,527, Italy, 207,617, Spain, 248,266, and Portugal, 203 989 quintals The Brazilian markets took 417,155 quintals in 1913

Fishery administration is a concern of the Department of Marine and Fisheries There is a Fishery Board of seven members, the Minister of Marine and Fisheries being Chairman.

The lobster fisheries having fallen off considerably during the last few years the Board have taken novel steps for their improvement Instead of trying costly and futile experiments on lobster hatching and rearing,[1] the Newfoundland Board provide for the

[1] See *Board of Agriculture and Fisheries (England) Annual Report on Sea Fisheries for 1913* Part I p 45

hatching of the lobster under natural conditions. Up to the present no successful attempts to rear lobsters on a large scale have been made except by the Bureau of Fisheries of the United States. In Newfoundland the lobster fishermen are licensed; and arrangements are made for the Board to purchase all berried lobsters caught by the fishermen. Since lobsters can be kept for weeks in the store pots this is a feasible undertaking. The experience of the Newfoundland authorities is that the berried lobster does not travel far, corroborating the experience of fishery authorities on the west coast of England. The berried lobsters are, therefore, "planted" on areas in which for the time being the setting of lobster traps or pots is prohibited. These areas are not necessarily extensive and do not appear to interfere with the fishing. On these reservations the lobster breeds under natural conditions. The sum of ten cents was paid by the Department for every berried lobster offered by the fishermen, and 51,000 berried lobsters were so purchased and placed on reserved ground in 1914.

The Department of Marine and Fisheries issues an Annual Report, that for 1914 being the seventeenth. In the Appendix for that year there is a report on lobster propagation, which should be read by all interested in that branch of the sea fisheries.

Union Of South Africa

PROVINCE OF THE CAPE OF GOOD HOPE

A marine biological report is published for the province. Volume II was the last pre-war volume, for the year ending 30th June, 1914. Published at Cape Town by the Cape Times Limited, Government Printers. During the year under review the yield of the coastal fisheries amounted to 116,000 cwt.; that of the steam trawlers 125,000 cwt.

Egypt

So far as can be ascertained the official Egyptian publications contain no statistical or other information on the sea fisheries.[1] The sea fisheries are mainly carried on by Italians who fish in small sailing boats in the coastal waters. Although there is only an inconsiderable market in Egypt for fresh sea fish, there is a considerable sale of imported and preserved products. In 1911 the imports of fish amounted to £134,615. Of this England claimed £44,382, the other leading countries being Portugal, £20,265; Italy, £13,209; France, £11,824; Norway, £10,852; and Spain, £9,423.

[1] Reference may, however, be made to "Report on the Edible Fishes of Lake Menzaleh, their Capture and Preservation," by J. C. Mitchell. Published ? n.d. Ministry of Public Instruction, 12th October, 1896.

FOREIGN FISHERIES EXTRA EUROPEAN

These fisheries, with the exception of the United States (p 250) and Japan, are but little developed

CHINA

In 1914 the Ministry of Agriculture and Commerce published regulations to encourage the fishing industry at sea [1] A sum of $50,000 was set aside in that year, this being an annual appropriation for the encouragement of the industry The inshore fisheries of China are unique in one respect, since the presence of piracy seems to be the chief obstacle to their development In the third year of the republic (1914) the Ministry started to establish fishery training schools along the coast, and several have already been established in the provinces of Chili, Chekiang, Fengtien, Fukien, and Kwangtung

JAPAN

The best résumé of the conditions in Japan is that given by Sir F A Nicholson in his *Note on fisheries of Japan*, Madras Government Press, 1907 Price 1 rupee 2 annas

SOUTH AMERICA

The fisheries of South America are not developed on modern lines

PERU

See *The Fisheries and the Guano Industry of Peru*, by R E Coker Proceedings of the Fourth International Fishery Congress Part I, pp 333–365, with six plates Washington, U S A August, 1910

[1] *Manchester Guardian* China number 21st September 1915 p 9a and *The Fisheries of China* by Wei Ching W Yen Proceedings of the Fourth International Fishery Congress Washington U S A Part I pp 369–373 August 1910

APPENDICES

APPENDIX I. The average price of the commoner trawl-caught fish at ports of landing, England and Wales, 1886–1893, 1903 and 1913.

APPENDIX II. Fish exports from the British Isles, 1912–13.

APPENDIX III. Table giving the average catch in cwts. per day's absence from port for the chief fishing grounds frequented by English and Welsh steam trawlers. 1906–13.

APPENDIX IV. Ymuiden market statistics. Catch in kilograms of different kinds of fish by steam trawlers in the North Sea per voyage day. 1904–11.

APPENDIX V. Relation of catch of demersal fish to fishing power expended by first-class trawlers landing fish from the North Sea at English East Coast ports (except London). 1903–13.

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APPENDIX VIII. Statistics of the German salt herring markets.

APPENDIX IX. The Scottish herring fisheries under the bounty system. Part I, 1750–99. Part II, 1809–35.

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APPENDIX I

STATEMENT SHOWING THE AVERAGE PRICE IN PENCE PER LB OF THE COMMON TRAWL CAUGHT FISH AS LANDED ON THE ENGLISH AND WELSH COASTS FOR THE YEARS 1886 1893 1903 AND 1913

(Extracted from the Official Returns)

Fish	1886	1893	1903	1913
Brill	—	5 51	5 38	7 69
Soles	9 34	14 47	14·09	14 94
Turbot	6 54	8 11	8 26	9 48
Cod	1 67	1 45	1 30	1 37
Conger	—	—	1 72	1 56
Dabs	—	—	1 34	2 01
Gurnards	—	—	70	67
Haddock	76	1 15	1 08	1 84
Halibut	—	3 80	4 46	7 02
Lemon Soles	—	—	5 26	5 85
Plaice	—	2 13	2 07	3 10
Skate and Rays	—	—	1 11	1 51
Whiting	—	—	92	1 40
Hake	—	1 38	1 44	2 27

For detailed statistics for intermediate years see Lancashire and Western Sea Fisheries Superintendent's Quarterly Report for quarter ending 30 September, 1912

II

Exports of Fish from the British Isles during 1912 and 1913

Fresh Fish

	1913. cwts.	1913. £	1912. cwts.	1912. £
Herrings . .	1,163,334	585,738	1,043,538	513,599
Haddock . .	47,280	58,518	56,729	70,325
Cod . . .	41,272	47,227	45,137	46,667
Mackerel . .	15,193	16,212	11,247	13,947
Salmon . . .	6,748	63,110	6,109	59,383
Shellfish . .	30,177	62,720	53,933	68,217
Unenumerated .	160,292	378,968	186,085	425,383
Total . .	1,464,296	1,212,493	1,402,778	1,197,521

Cured Fish

	1913. cwts.	1913. £	1912. cwts.	1912. £
Herrings . .	8,797,106	5,333,113	8,356,232	4,600,260
Cod . . .	441,969	601,914	411,085	509,714
Haddock . .	33,793	58,394	41,428	61,932
Mackerel . .	98,379	79,381	133,797	114,984
Pilchards . .	37,033	38,515	48,892	50,661
Salmon . . .	379	2,050	295	1,600
Unenumerated .	121,559	175,241	138,678	184,827
Total . .	9,530,218	6,288,608	9,130,407	5,523,978

The Cured Herrings.

	1913. cwts.	1913. £	1912. cwts.	1912. £
Russia . . .	3,566,155	1,988,177	3,310,073	1,619,294
Germany . .	3,996,992	2,267,108	3,851,284	1,933,109
Norway . .	38,593	17,509	11,254	5,298
Netherlands . .	167,641	89,807	111,963	65,283
Belgium . .	222,505	142,673	217,213	133,259
Italy . . .	91,590	89,936	135,703	133,701
Greece . . .	42,169	45,448	30,378	31,500
United States. .	400,389	323,191	434,236	340,815
British West Africa	16,720	22,052	—	—
Union of S. Africa .	23,146	36,315	21,976	31,905
Australia . .	71,655	117,552	69,369	105,759
New Zealand . .	11,656	19,874	13,621	22,093
Canada . . .	28,993	29,830	24,605	26,186
Other Countries .	118,902	146,641	124,557	152,058
Total . .	8,797,106	5,333,113	8,356,232	4,600,260

III

Average Catch in cwts per Day's Absence from Port

steam trawlers (england and wales) only

	1906	1907	1908	1909	1910	1911	1912	1913
White Sea	40 15	43 14	47 40	59 88	60 08	49 24	38 13	44 12
Iceland	44 22	44 16	47 96	43 61	44 35	48 05	46 05	46 10
Faroe	31 19	34 35	28 07	34 94	30 27	31 49	31·69	28 19
Rockall	38 98	41 18	33 30	39 51	14 74	29 28	41 90	39 27
North of Scotland	25 01	37 90	33 34	26 50	24 79	24 24	23 72	25 76
North Sea	17 60	17 07	16 58	16 95	16 20	16 23	15 76	14 08
English Channel	11 36	10 50	16 36	13 61	12 40	12 48	13 80	8 95
Irish Sea	15 66	15 39	15 56	14 38	12 23	12 48	14 02	11 94
Bristol Channel	13 15	16 75	13 84	14 95	17 03	17·74	15 65	13 98
West of Scotland	21 18	22 61	23 30	23 88	26 24	28 09	31 73	28 11
West of Ireland	21 48	25 49	23 77	25 82	27 26	30 66	31 88	30 22
South of Ireland	26 97	26 92	24 79	25 81	24 27	25 89	28 94	23 74
Biscay	15 98	19 46	18 60	17 28	20 15	19 31	16 31	13 22
Portugal and Morocco	6 55	4 57	7 96	8 58	12 16	11 55	9 55	13 81

IV

Ymuiden Market Statistics

CATCH BY STEAM TRAWLERS (IN KILOS) IN NORTH SEA PER VOYAGE-DAY

	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.
Turbot	23·9	23·7	20·8	17·2	15·7	14·3	15·2	17·0
Brill	4·4	3·3	3·9	4·3	4·0	3·5	4·1	4·2
Large Soles	3·7	3·4	4·0	4·7	4·0	3·1	3·2	3·6
Medium Soles	7·9	10·2	10·0	8·1	5·5	4·5	4·7	4·7
Small Soles	3·8	3·0	2·1	2·6	2·1	1·7	2·0	2·3
Total Soles	15·4	16·6	16·1	15·4	11·6	9·3	9·9	10·6
Large Plaice	6·2	6·3	6·5	5·5	6·1	4·6	5·1	6·1
Medium Plaice	10·1	8·1	7·5	6·3	5·6	5·0	6·1	7·3
Small Plaice	58·0	61·8	38·3	53·1	41·8	37·3	39·9	59·5
Extra small Plaice	312·2	236·6	184·2	245·0	196·5	253·2	267·3	277·9
Total Plaice	386·5	312·8	236·5	309·9	250·0	300·1	318·4	350·8
Dabs	90·8	68·3	71·8	53·3	44·9	46·0	38·0	16·3
Large Haddock	13·6	14·2	21·5	21·5	21·6	23·7	41·0	31·8
Large Medium Haddock	21·0	29·5	24·4	18·7	37·2	36·7	34·5	22·7
Small Medium Haddock	138·8	84·2	35·0	78·1	139·9	77·7	59·1	62·5
Small Haddock	107·3	78·5	284·9	190·3	103·7	68·0	89·7	78·3
Total Haddock	280·7	206·4	365·8	308·6	302·4	206·1	224·3	195·3
Cod	44·8	50·1	29·0	36·1	40·2	47·7	43·5	70·4
Codling	29·0	20·8	23·8	22·9	32·0	53·3	62·6	55·0
Total	73·8	70·9	52·8	59·0	72·2	101·0	106·1	125·4
Grand Total	1075·2	893·3	905·0	905·8	837·7	817·6	875·5	862·1

The detailed figures are extracts only and not complete lists. Consequently the grand total does not agree with the additions.

V

Board of Agriculture and Fisheries, Annual Report on Sea Fisheries for the year 1913 Part II Tables and Charts, p 101. Table IX Relation of catch of demersal fish to fishing power expended by first-class trawlers landing fish from the North Sea at East Coast ports (except London), 1903–13

Year	Steam			Sail		
	Quantity landed cwts.	Number of days' absence.	Average catch per day cwts.	Quantity landed cwts	Number of days absence.	Average catch per day cwts
1903 .	3,801,461	203,985	18 64	277,530	89,159	3 11
1904 .	3,259,270	198,835	16 39	265,389	100,553	2 64
1905 .	2,960,147	182,873	16 19	296,232	102,884	2 88
1906 .	2,896,596	164,321	17 63	262,129	106,867	2 45
1907 .	2,793,196	163 582	17 08	274,915	109,573	2 51
1908 .	2,649,746	159,842	16 58	285,664	109 906	2 60
1909 .	2,504,751	147,807	16 95	279,890	93,796	2 98
1910	2,305,305	142,269	16 20	233,962	78,430	2 98
1911 .	2,295,336	141,418	16 23	245,424	78,577	3 12
1912	2,246,813	142,524	15 76	278,079	90,406	3 08
1913 .	2,073,313	147,284	14 08	266,464	91,978	2 90

VI

England and Wales

TOTAL QUANTITY OF PLAICE LANDED FROM VARIOUS AREAS

(*weights in cwts.*)

	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
White Sea . . .	39,176	81,261	120,951	288,962	255,995	255,708	110,848	59,196
Iceland . . .	186,382	172,352	124,531	100,263	90,739	101,153	121,264	96,245
Faroe	4,350	3,175	1,664	1,558	1,299	1,234	989	1,595
Rockall . . .	51	39	4	20	0	9	0	2
North of Scotland .	173	190	355	561	495	560	423	184
North Sea . . .	572,307	651,006	610,796	592,326	507,721	537,017	529,878	485,252
English Channel . .	22,073	25,269	27,752	24,450	26,376	30,751	28,240	21,716
Irish Sea . . .	12,070	17,460	18,420	22,362	40,271	44,151	27,941	30,787
Bristol Channel . .	2,906	3,376	4,607	3,694	3,131	4,405	3,461	2,134
Westward of Scotland .	2,770	6,673	8,198	12,429	8,317	5,097	4,594	757
West of Ireland . .	3	0	5	0	1	47	29	3
Southward of Ireland .	1,991	3,804	4,089	3,277	4,214	3,649	2,272	1,463
Biscay . . .	27	7	8	3	25	4	0	0
Portugal and Morocco .	7	1	0	0	0	4	3	1
Not distinguished . .	8,864	1,703	2,232	1,490	2,878	2,376	4,329	1,963
Total . . .	853,150	966,316	923,603	1,051,665	941,642	986,165	834,271	699,298

CLASSIFICATION ACCORDING TO SIZES

	1906	1907	1908	1909	1910	1911	1912	1913
Large	340 587	287 081	258 568	269 849	225 610	229 153	190 206	158 126
Medium	265 696	328 613	334 181	426 995	425 396	442 146	353 446	276 957
Small	189 832	300 653	272 238	295 323	235 834	287 993	246 385	237 183
Undistinguished	57 035	49 969	58 616	59 498	54 622	26 873	44 234	27 032
Total	853 150	966 316	923 603	1 051 665	941 462	986 165	834 271	699 298

PLAICE LANDED IN ENGLAND AND WALES

STEAM TRAWLER RETURNS

QUANTITY (IN CWTS) CAUGHT PER DAY'S ABSENCE FROM PORT

	1906	1907	1908	1909	1910	1911	1912	1913
White Sea	34 70	38 42	40 45	50 39	46 32	33 72	20 15	20 95
Iceland	5 32	5 08	3 92	3 71	3 08	3 35	3 92	2 60
North Sea	2 15	2 41	2 36	2 30	2 38	2 57	2 34	2 09
English Channel	0 82	1 47	2 64	2 20	3 37	3 22	3 19	2 76
Irish Sea	1 18	0 61	0 70	1 16	1 82	1 41	1 30	1 09

VII

Tables showing the quantity of soles taken by steam trawlers by first-class and second- and third-class sailing trawlers in the four chief sole-producing areas of the British Isles, for the period 1906–13.

QUANTITY OF SOLES (IN CWTS.) LANDED FROM NORTH SEA

	Steam.	Sail (first class).	Sail (second and third class).	Total.	Percentage of whole catch.
1906 . .	21,987	16,495	1,194	39,677	61·68
1907 . .	19,627	16,994	1,256	37,878	60·22
1908 . .	17,270	16,801	1,132	35,206	53·67
1909 . .	13,728	15,023	1,233	29,984	46·76
1910 . .	9,663	13,167	1,244	24,075	41·33
1911 . .	11,601	12,100	1,386	25,087	40·89
1912 . .	12,860	17,541	1,129	31,530	45·18
1913 . .	11,651	17,482	994	30,127	45·38
IRISH SEA					
1906 . .	83	1,172	1,872	3,127	4·86
1907 . .	531	1,743	2,422	4,696	7·46
1908 . .	605	4,295	984	5,884	8·97
1909 . .	871	5,531	1,489	7,891	12·31
1910 . .	4,348	5,311	1,476	11,135	19·11
1911 . .	8,224	4,644	1,247	14,115	23·01
1912 . .	9,615	3,472	1,173	14,260	20·43
1913 . .	11,037	2,532	1,120	14,689	22·13
BRISTOL CHANNEL					
1906 . .	355	6,299	196	6,850	10·65
1907 . .	480	5,120	63	5,664	9·00
1908 . .	250	9,936	77	10,263	15·65
1909 . .	429	9,756	112	10,297	16·06
1910 . .	647	10,891	146	11,684	20·06
1911 . .	1,433	9,659	97	11,189	18·24
1912 . .	3,758	9,860	104	13,722	19·66
1913 . .	3,572	7,587	121	11,280	16·99
ENGLISH CHANNEL					
1906 . .	240	3,756	3,003	7,000	10·88
1907 . .	236	4,439	2,266	7,122	11·32
1908 . .	188	3,627	2,466	6,472	9·87
1909 . .	416	3,500	2,337	6,558	10·23
1910 . .	277	2,939	2,073	5,524	9·48
1911 . .	387	3,909	2,080	6,732	10·97
1912 . .	465	4,190	1,818	6,703	9·61
1913 . .	563	4,776	1,727	7,238	10·90

VIII

German Salt Herring Markets

ANNUAL AVERAGES, EXPRESSED AS BARRELS, 1885–1910

Years.	Germany's own production	Imports from Great Britain.	Holland	Norway	Sweden	Total imports
1885–9	11,716	537,605	236,263	224,951	—	1,091,647
1890–4	21,698	565,749	354,557	272,346	—	1,249,619
1895–9	79,804	589,169	302,543	206,576	—	1,155,205
1900–4	169,679	642,103	435,225	141,442	9,994	1,232,014
1905–9	347,168	687,611	443,834	100,164	7,982	1,242,682
1910	501,771	631,249	462,865	173,504	?	1,278,957

Calculated from statistical tables published in the *Geschaftsberichten der Emder Heringsfischerı A G.*, the *Statistischen Handbuch fur das Deutsche Reich*, the *Statistischen Jahrbuchern fur das Deutsche Reich*, and the *Mitteilungen des Deutschen Seefischerei Vereins* In 1910 the totals refer to " Kantjes."—17 Kantjes (sea-packed) equal 13 barrels (hand-packed)

IX

The Scottish Herring Buss Fisheries under the Bounty System

ANNUAL AVERAGES—PART I 1750–99, PART II 1809–35

Part I—1750–99

Years	Number of busses	Tonnage.	Number of tons.	Barrels of herring	Remarks
1751–6	3	218	48	264	Bounty 30s per ton
1757–65	50	2,188	513	8 025	Bounty 50s per ton
1766–1770	166	7,863	1,817	16 909	Ditto, but not regularly paid
1771–1786	191	9,094	2 108	29,087	Bounty 30s per ton
1787–1798	293	14,256	3,330	59 157	Bounty 20s per ton, and 4s per barrel of herring conditionally (see p 119)

The year selected by Adam Smith as illustration in *The Wealth of Nations* was 1759, the only year in which the fishery was a complete failure Number of busses 3, tonnage 181, number of men 41, barrels of herring 4

Part II—1809–35

Years.	Fishermen and boys *a*	Total *persons* employed *a*	Barrels of *herring* cured	Barrels entitled to Crown brand	Tonnage *bounty b* £	Bounty on herrings. *c* £
1809–18	—	—	164,127	104,994	1,812	17 561
1819–28	41,908	78,922	385,341	274,253	3,162	47,404
1829–35	47,973	81,844	396,431	176,714	—	10,290

a These statistics commence in 1825
b These statistics end in 1824
c These statistics end in 1829

X

Estimate of Value of World's Sea Fisheries[1]

EUROPE

Country.	Year of estimate.	Value of products (£s).	Remarks.
British Isles	1913	14,629,342	
France	1911	5,582,736	Includes Algeria.
Germany	1913	2,211,981	
Holland	1911	1,378,597	
Belgium	1912	232,560	
Norway	1912	3,009,531	
Portugal	1910	1,415,664	
Denmark	1912	925,951	
Russia in Europe	1908	230,000	
Spain	1904	1,828,090	
Italy	1910	960,468	
Austria	1911–12	433,028	
Sweden	1911–12	437,285	
Total European		33,275,233	

EXTRA-EUROPEAN

United States		15,200,000	Includes river & lake fisheries
Japan	1912	9,277,777	Includes fresh water „
Canada		6,863,389	„ „ „
Newfoundland and Labrador	1910	1,969,000	Excludes fish consumed locally.
Alaska	1910	2,762,000	
Australia	1909	356,000	Excluding pearl fisheries.
New Zealand	1911	30,342	
Natal	1909	22,000	
Bahama Islands		115,528	Sponge fisheries.
Turks and Caicos Islands		2,416	
Tunis	1904	216,000	

[1] See also *International Fishery Statistics*, by R. H. Rew, Institut international de Statistique. Rapport No. 24. La Haye, 1911.

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The following list contains only the more important works of reference Other references are given in footnotes

I

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In order of date Full titles are not given but sufficient information for purposes of identification

1785 Report of Committee on Pilchard Fisheries
1785 Report of Committee on British Fisheries Three reports
1786 Report of Committee on Pilchard Fisheries
1786 Report of Committee on British Fisheries Four reports
1798 Report of Committee on British Herring Fisheries Three reports
1799 Report of Committee on British Herring Fisheries One report
1800 Report of Committee on British Herring Fisheries Two reports
1839 Royal Commission Irish Fisheries Reports I and II
1863 Royal Commission Trawling for Herring Scotland (C 3106, 3106 I)
1866 Royal Commission Sea Fisheries Vols I and II
1870 Report Coast and Deep-Sea Fisheries Ireland (C 226)
1878 Report Herring Fisheries Scotland (C 1979)
1879 Commission Sea Fisheries England and Wales (C 2449)
1881 Outrages by Foreign Fishermen in North Sea (C 2878)
1883 Sea Fishing Trade Committee (C 3432)
1885 Royal Commission on Trawling (C 4324)
1887 Mussel Beds and Drying Gronnds Scotland (C 5157)
1888 Liquor Traffic in North Sea (C 5263)
1889 Scottish Mussel and Bait Beds (C. 5660)
1893 Select Committee on Sea Fisheries (377)
1900 Select Committee on Sea Fisheries Bill (287)
1901 Sea Fisheries Restrictive Legislation in Foreign Countries (271)
1902 Committee on Fishery Statistics (C 1063)
1903 Committee on Ichthyological Research
1904 Select Committee (House of Lords) Sea Fisheries Bill (36)
1904 Whaling North of Scotland (C 2138 and C 2153)
1905 Sea Fisheries Sutherland and Caithness (C 2557 and 2608)
1908 Committee on Fishery Investigations (C 4268 and 4304)
1913 Committee on Scientific Research England and Wales (C 7200)
1914 Committee North Sea Fishing Industry Scotland (C 7221)
1914 Inshore Fisheries England and Wales (C 7373 and 7374)

II

Sea Fishery Statistics

For Great Britain. Published by the Board of Trade from 1878 to 1903—
(1) As quantity of fish conveyed inland by rail, and
(2) As Statistical tables and memorandum.
See also "Statistical tables and charts of British and Foreign Trade and Industry." (C. 4954. 1854–1908.)
For plaice fisheries. Special reports by Board of Agriculture and Fisheries, C. 4227 (1908); C. 4738 (1909); C. 5362 (1910), and C. 5686 (1911). Series II, Vol. II, Nos. 1–5 (1915). Vol. III, Nos. 2–3 (1916).
Statistical tables relating to catch of plaice, haddock, cod and hake during five years 1906–10. London, 1912.
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For haddock, Bd. of A. and F. Report on Market measurements, 1909–11. Series II, Vol. I, Parts I and II.
See also Annual Reports of the various Government departments III below.

III

Departmental Reports (British Isles)

The student of sea-fishery problems should consult the annual reports of the various central departments of Government engaged in sea-fishing administration. These are:—

England and Wales—
Reports of the Inspectors of Sea Fisheries (England and Wales).
Seventeen Annual Reports for years 1886–1902 inclusive.
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Annual Report on Sea Fisheries for the years 1912 to 1914.

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Ireland—
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Part I. General Reports for years 1902 to 1907 inclusive.
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In and after 1908, the Annual Report of the Fisheries Branch of the Department was issued as one volume.
Reports for 1908 to 1913 inclusive.
See also Reports of Congested Districts Board for Ireland.

The Reports of the Annual Conference of Local Sea Fishery Authorities in England and Wales should also be consulted

Sea Fisheries Annual Conferences, 1891–1915—

Titles of first and last only given here

First Annual Meeting of representatives of Authorities under the Sea Fisheries Regulation Act, 1888 Tuesday, 9th June, 1891 London 1891

Ditto *Ditto* 2nd *to* 19th *inclusive*—

Reports of Proceedings at the Twenty fifth Annual Meeting of representatives of Authorities under the Sea Fisheries Regulation Act, 1888 C 8018, London, 1915

The Annual Reports of the Development Commissioners should also be consulted

The "literature" dealing with the International Fishery Investigations is of a voluminous nature It is impossible to give here even a list of the titles of the more important papers Reference may, however, be made to the following which have been published as British "Bluebooks" and give an idea of the extent of these publications

NORTH SEA FISHERIES—

1903 Reports of the British Delegates attending the International Conferences held at Stockholm, Christiania, and Copenhagen, with respect to Fishery and Hydrographical Investigations in the North Sea, and correspondence relating thereto Vol I (C 1313)

See also Report, Vol I (C 2966) General Report, Vol II (C 3033) Report (C 3165) Reports (C 5032)

Report on Fishery and Hydrographical Investigations in the North Sea and adjacent waters, 1902–3 —

1905 First Report—Northern Area 1902–1903 (C 2612)

1905 First Report—Southern Area, 1902–1903 (2 copies) (C 2670)

1904–1905 Second Report—Southern Area Part I (C 3837, 1907), Part II (C 4641, 1909)

1911 Third Report—Southern Area, 1906–1908 (C 5546)

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1912 Fourth Report—Southern Area, 1909 (C 6125)

1913 Fifth Report—Northern Area 1908–1911 (Fishery Board for Scotland) (C 6950)

1904–1905 Second Annual Northern Area Part I Hydrography (Cd 3358)

1904–1906 Third Annual Northern Area Statistical Papers (Cd 4350)

1906–1908 Fourth Annual Northern Area Hydrography (Cd 4893 1909)

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IV

BOOKS ON SEA FISHERIES

There are a number of more or less popular publications which profess to deal with British Sea Fisheries For the most part these may safely be ignored There are however, one or two which should be studied

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FRASER, ROBERT. *A Review of the Domestic Fisheries of Great Britain and Ireland.* Edinburgh, 1818.

FULTON, T. WEMYSS. *The Sovereignty of the Sea.* Edinburgh, 1911.

HOLDSWORTH, E. W. H. *Deep-sea Fishing and Fishing Boats.* London, 1874.

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V

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WESTWOOD, T., and SATCHELL, T. *Bibliotheca Piscatoria.* London, 1883.

Refers mainly to angling.

BOSGOED, D. M. *Bibliotheca Ichthyologica et Piscatoria.* Haarlem, 1874.

The following three lists deal for the most part with marine biology. Still there are some important papers on sea-fishery subjects.

(1) List of publications recording the result of researches carried out under the auspices of the Marine Biological Association of the United Kingdom in their laboratory at Plymouth or on the North Sea Coast from 1886–1913.
Journal Marine Biological Assoc. of the U.K. Vol. X, No. 1. Nov., 1913.

(2) *The Gatty Marine Laboratory and the Steps which led to its Foundation in the University of St. Andrews.* By W. C. McIntosh. Pub. John Leng & Co. Dundee, 1896. Contains list of papers (225) published before and after the opening of the Marine Laboratory at St. Andrews. There are several supplementary lists, bringing the total up to 369 to end of 1911.

(3) General Index to the Scientific Reports of the Fishery Board for Scotland, 1883–1904, with a list of papers contained in them. By Dr. T. Wemyss Fulton. *Twenty-Third Annual Report S.F.B.*, 1904, Part III. Published Aug., 1905.

Board of Agriculture and Fisheries. Fisheries Notice No. 6.
Publications relating to Fisheries. Published Oct., 1914.
Contains list of fishery publications under five headings. (1) Annual Reports. (2) Fishery Investigations. (3) Departmental Committees. (4) General Information. (5) Miscellaneous.

Students of the wider aspect of fishery questions should consult—
"Fishes." List of United States Government publications. For sale by the Superintendent of Documents. Washington, D.C. Washington Government Printing Office. Sept., 1911.

Although most of the titles in this brochure deal with subjects of remote interest to the student of British fisheries, there are some which should be consulted, e.g. under head "Lobsters." "Oysters."

VI

Pollution of Tidal Waters

There are two important reports by Bulstrode —

On Oysters (C 8214, 1896)

On Shellfish other than Oysters (C 5313, 1911)

See also the Reports of the Royal Commission on Sewage disposal It is unnecessary to consult the complete report The most important sections are

Pollution of tidal waters, with special reference to contamination of shellfish (C 1883 and 1884) 1904

Pollution of estuaries (C 4284) 1908

Final report (C 7281) 1915

VII

Natural History of Fish

Scientific investigations into problems having more or less bearing on the Sea Fisheries are recorded in numerous publications It would be extremely difficult to give a list in moderately small compass

Reference should however, be made to volumes dealing with the life histories of edible marine fish, as otherwise it is impossible properly to understand the subject The most important of these are —

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